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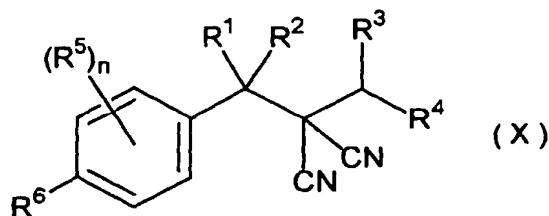
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(54) Title: PESTICIDE COMPOSITION COMPRISING MALONONITRILE COMPOUNDS



(57) Abstract: The present invention relates to use of malononitrile compounds of formula (X): wherein R₁ and R₂ are the same or different and independently C¹-C⁵ (halo)alkyl, C¹-C⁵ (halo)alkyloxy, C²-C⁵ (halo)alkenyl, C²-C⁵ (halo)alkynyl, hydrogen, or cyano; R₃ and R₄ are the same or different and independently C¹-C¹⁰ alkyl, C²-C¹⁰ alkenyl, C²-C¹⁰ alkynyl, or hydrogen, or R₃ and R₄ are taken together to form C²-C⁶ (halo)alkylene or C⁴-C⁶ (halo)alkenylene; R₅ is halogen, cyano, nitro, C¹-C⁴ (halo)alkyl, or the like; n is an integer of 0 to 4; R₆ is halogen, cyano, nitro, C¹-C⁴ (halo)alkyl, or the like; or R₅

and R₆ are taken together to form methylenedioxy; with the provisos that when R₆ is hydrogen, then n is an integer of 1 to 4 and that when n is 2 or more, then R₅'s are different from each other; as pesticides, and to pesticide compositions containing these compounds as active ingredients. The present invention makes it possible to effectively control pests such as insect pests, acarine pests, and nematode pests.

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DESCRIPTION
PESTICIDE COMPOSITION COMPRISING MALONONITRILE
COMPOUNDS

5 Technical Field

The present invention relates to pesticide compositions comprising the malononitrile compounds as active ingredients and to use of certain malononitrile compounds as pesticides.

10 Background Art

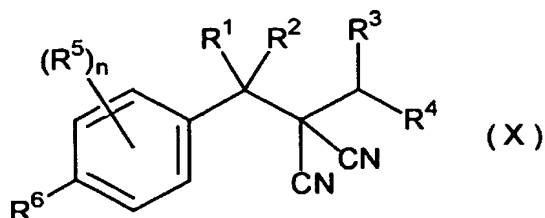
Against pests such as insect pests, acarine pests, and nematode pests, various pesticide compositions have been used so far for their control. The conditions of pesticide compositions required have drastically been changed, including the care of their effects on the environment and the acquisition of
15 drug resistance by pests to be controlled. Under such circumstances, there have been great demands for the development of new pesticide compositions.

Disclosure of Invention

The present inventors have extensively studied to find compounds
20 having excellent pest controlling activity. As a result, they have found that the malononitrile compounds of formula (X) as depicted below have excellent controlling activity against pests such as insect pests, acarine pests, and nematode pests, thereby reaching the present invention.

25 That is, the present invention provides a pesticide composition comprising malononitrile compounds of formula (X):

2



(hereinafter referred to as compound(s) (X))

wherein R^1 and R^2 are the same or different and independently C_1 - C_6 (halo)-alkyl, C_1 - C_6 (halo)alkyloxy, C_2 - C_6 (halo)alkenyl, C_2 - C_6 (halo)alkynyl, hydrogen, or cyano;

R^3 and R^4 are the same or different and independently C_1 - C_{10} alkyl, C_2 - C_{10} alkenyl, C_2 - C_{10} alkynyl, or hydrogen, or R^3 and R^4 are taken together to form C_2 - C_6 (halo)alkylene or C_4 - C_6 (halo)alkenylene;

R^5 is halogen, cyano, nitro, C_1 - C_4 (halo)alkyl, C_2 - C_4 (halo)alkenyl, C_2 - C_4 (halo)alkynyl, C_1 - C_4 (halo)alkyloxy, C_1 - C_4 (halo)alkylthio, C_1 - C_4 (halo)alkylsulfinyl, C_1 - C_4 (halo)alkylsulfonyl, C_1 - C_4 (halo)alkylcarbonyl, C_1 - C_4 (halo)alkyloxycarbonyl, C_1 - C_4 (halo)alkylcarbonyloxy, phenoxy, or phenylthio, in which the phenoxy and phenylthio groups may optionally be substituted with halogen or C_1 - C_3 alkyl;

n is an integer of 0 to 4;

R^6 is hydrogen, halogen, cyano, nitro, C_1 - C_4 (halo)alkyl, C_2 - C_4 (halo)alkenyl, C_2 - C_4 (halo)alkynyl, C_1 - C_4 (halo)alkyloxy, C_1 - C_4 (halo)alkylthio, C_1 - C_4 (halo)alkylsulfinyl, C_1 - C_4 (halo)alkylsulfonyl, C_1 - C_4 (halo)alkylcarbonyl, C_1 - C_4 (halo)alkyloxycarbonyl, C_1 - C_4 (halo)alkylcarbonyloxy, phenoxy, or phenylthio, in which the phenoxy and phenylthio groups may optionally be substituted with halogen or C_1 - C_3 alkyl;

or R^5 and R^6 are taken together to form methylenedioxy;

with the provisos that when R^6 is hydrogen, then n is an integer of 1 to 4 and that when n is 2 or more, then R^5 's are the same or different from each other;

as an active ingredient.

The present invention also provides use of compounds (X) as active ingredients and pest controlling methods by applying compounds (X) to pests or habitats of pests.

5 Mode for Carrying Out the Invention

In the definition of substituents as used herein, each group has the following meaning:

The (halo)alkyl group refers to alkyl optionally substituted with halogen for one or more than one hydrogen atoms.

10 The (halo)alkyloxy group refers to alkyloxy optionally substituted with halogen for one or more than one hydrogen atoms.

The (halo)alkenyl group refers to alkenyl optionally substituted with halogen for one or more than one hydrogen atoms.

15 The (halo)alkynyl group refers to alkynyl optionally substituted with halogen for one or more than one hydrogen atoms.

The (halo)alkylene group refers to alkylene optionally substituted with halogen for one or more than one hydrogen atoms.

The (halo)alkenylene group refers to alkenylene optionally substituted with halogen for one or more than one hydrogen atoms.

20 The (halo)alkylthio group refers to alkylthio optionally substituted with halogen for one or more than one hydrogen atoms.

The (halo)alkylsulfinyl group refers to alkylsulfinyl optionally substituted with halogen for one or more than one hydrogen atoms.

25 The (halo)alkylsulfonyl group refers to alkylsulfonyl optionally substituted with halogen for one or more than one hydrogen atoms.

The (halo)alkylcarbonyl group refers to alkylcarbonyl optionally substituted with halogen for one or more than one hydrogen atoms.

The (halo)alkyloxycarbonyl group refers to alkyloxycarbonyl option-

ally substituted with halogen for one or more than one hydrogen atoms.

The (halo)alkylcarbonyloxy group refers to alkylcarbonyloxy optionally substituted with halogen for one or more than one hydrogen atoms.

The term "C₁-C₁₀" or the like refers to the number of carbon atoms constituting the alkyl, alkenyl, or alkynyl group in each substituent. For example, C₁-C₄ (halo)alkylcarbonyl means alkylcarbonyl optionally substituted with halogen for one or more hydrogen atoms wherein the alkyl part is constituted by C₁-C₄ carbon atoms.

In compounds (X), each group includes specific ones as listed below:

The C₁-C₆ (halo)alkyl group represented by R¹ or R² may include methyl, ethyl, propyl, 1-methylethyl, 1,1-dimethylethyl, 2,2-dimethylpropyl, chloromethyl, fluoromethyl, difluoromethyl, trifluoromethyl, 2,2,2-trifluoroethyl, and 1,1,2,2-tetrafluoroethyl.

The C₁-C₆ (halo)alkyloxy group represented by R¹ or R² may include methoxy, ethoxy, 1-methylethoxy, trifluoromethoxy, difluoromethoxy, 2,2,2-trifluoroethoxy, and 1,1,2,2-tetrafluoroethoxy.

The C₂-C₆ (halo)alkenyl group represented by R¹ or R² may include vinyl, 1-propenyl, 2-propenyl, 2,2-difluorovinyl, and 1,2,2-trifluorovinyl.

The C₂-C₆ (halo)alkynyl group represented by R¹ or R² may include ethynyl, 1-propynyl, 2-propynyl and 3,3,3-trifluoro-1-propynyl.

The C₁-C₁₀ alkyl group represented by R³ or R⁴ may include methyl, ethyl, 1-methylethyl, propyl, 2-methylpropyl, 2,2-dimethylpropyl, butyl, 3-methylbutyl, and 3,3-dimethylbutyl.

The C₂-C₁₀ alkenyl group represented by R³ or R⁴ may include vinyl, allyl, 1-propenyl, 3-butenyl, 2-methyl-1-propenyl, 3-methyl-2-butenyl, 3-pentenyl, 4-pentenyl, 3-methyl-3-butenyl, and 4-methyl-3-pentenyl.

The C₂-C₁₀ alkynyl group represented by R³ or R⁴ may include ethynyl, 1-propynyl, 2-propynyl, 1-butyne, 3-methyl-1-butyne, and 3,3-di-

methyl-1-butynyl.

The C₂-C₆ (halo)alkylene group represented by R³ and R⁴ taken together may include ethylene, propylene, trimethylene, tetramethylene, and 3,3-dimethyltrimethylene.

5 The C₄-C₆ (halo)alkenylene group represented by R³ and R⁴ taken together may include 2-butenylene and 2-pentenylene.

The halogen atom represented by R⁵ or R⁶ may include fluorine, chlorine, bromine, and iodine.

10 The C₁-C₄ (halo)alkyl group represented by R⁵ or R⁶ may include methyl, ethyl, propyl, 1-methylethyl, 1,1-dimethylethyl, trifluoromethyl, pentafluoroethyl, 3,3,3-trifluoroethyl, and 1,1,2,2-tetrafluoroethyl.

The C₂-C₄ (halo)alkenyl group represented by R⁵ or R⁶ may include vinyl, 1-propenyl, 2-propenyl and 2,2-difluorovinyl.

15 The C₂-C₄ (halo)alkynyl group represented by R⁵ or R⁶ may include ethynyl, 1-propynyl, 2-propynyl and 3,3,3-trifluoro-1-propynyl.

The C₁-C₄ (halo)alkyloxy group represented by R⁵ or R⁶ may include methoxy, ethoxy, propoxy, trifluoromethoxy, bromodifluoromethoxy, difluoromethoxy, chlorodifluoromethoxy, pentafluoroethoxy, 2,2,2-trifluoroethoxy, and 1,1,2,2-tetrafluoroethoxy.

20 The C₁-C₄ (halo)alkylthio group represented by R⁵ or R⁶ may include methylthio, trifluoromethylthio, 2,2,2-trifluoroethylthio, and 1,1,2,2-tetrafluoroethylthio.

The C₁-C₄ (halo)alkylsulfinyl group represented by R⁵ or R⁶ may include methylsulfinyl and trifluoromethylsulfinyl.

25 The C₁-C₄ (halo)alkylsulfonyl group represented by R⁵ or R⁶ may include methylsulfonyl and trifluoromethylsulfonyl.

The C₁-C₄ (halo)alkylcarbonyl group represented by R⁵ or R⁶ may include acetyl, propionyl, and trifluoroacetyl.

The C₁-C₄ (halo)alkyloxycarbonyl group represented by R⁵ or R⁶ may include methoxycarbonyl and 2,2,2-trifluoroethoxycarbonyl.

The C₁-C₄ (halo)alkylcarbonyloxy group represented by R⁵ or R⁶ may include acetyloxy, propionyloxy, and trifluoroacetyloxy.

- 5 The phenyloxy optionally substituted with halogen or C₁-C₃ alkyl, which is represented by R⁵ or R⁶, may include phenoxy, p-methylphenoxy, m-methylphenoxy, and p-chlorophenoxy.

10 The phenylthio group optionally substituted with halogen or C₁-C₃ alkyl, which is represented by R⁵ or R⁶, may include phenylthio, p-methylphenylthio, m-methylphenylthio, and p-chlorophenylthio.

The embodiments of compounds (X) may include the following compounds:

The malononitrile compounds of formula (X) wherein R¹ is hydrogen, and R² is C₁-C₅ (halo)alkyl, C₂-C₅ (halo)alkenyl, or hydrogen;

- 15 The malononitrile compounds of formula (X) wherein R¹ and R² are both hydrogen;

The malononitrile compounds of formula (X) wherein R³ is C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, or hydrogen; R⁴ is C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, or C₂-C₁₀ alkynyl;

- 20 The malononitrile compounds of formula (X) wherein R³ is hydrogen and R⁴ is C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, or C₂-C₁₀ alkynyl;

The malononitrile compounds of formula (X) wherein R³ is hydrogen and R⁴ is C₁-C₁₀ alkyl or C₂-C₁₀ alkenyl;

- 25 The malononitrile compounds of formula (X) wherein R³ is hydrogen and R⁴ is C₁-C₁₀ alkyl;

The malononitrile compounds of formula (X) wherein R⁵ is halogen, n is an integer of 0 to 2;

The malononitrile compounds of formula (X) wherein R⁶ is halogen,

cyano, nitro, C₁-C₄ haloalkyl, C₁-C₄ haloalkyloxy, or C₁-C₄ haloalkylthio;

The malononitrile compounds of formula (X) wherein R⁵ is halogen, n is an integer of 0 to 2, and R⁶ is halogen, cyano, nitro, C₁-C₄ (halo)alkyl, C₁-C₄ (halo)alkyloxy, or C₁-C₄ (halo) alkylthio;

- 5 The malononitrile compounds of formula (X) wherein R³ is hydrogen; R⁴ is C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, or C₂-C₁₀ alkynyl, R⁵ is halogen, n is an integer of 0 to 2, and R⁶ is halogen, cyano, nitro, C₁-C₄ (halo)alkyl, C₁-C₄ (halo)alkyloxy, or C₁-C₄ (halo) alkylthio;

- 10 The malononitrile compounds of formula (X) wherein R¹ is hydrogen, R² is C₁-C₆ (halo)alkyl, C₂-C₆ (halo)alkenyl, or hydrogen, R³ is hydrogen; R⁴ is C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, or C₂-C₁₀ alkynyl, R⁵ is halogen, n is an integer of 0 to 2, and R⁶ is halogen, cyano, nitro, C₁-C₄ (halo)alkyl, C₁-C₄ (halo)alkyloxy, or C₁-C₄ (halo) alkylthio;

- 15 The malononitrile compounds of formula (X) wherein R⁴ is vinyl and R⁶ is trifluoromethyl;

The malononitrile compounds of formula (X) wherein R⁴ is vinyl and R⁶ is difluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is vinyl and R⁶ is trifluoromethoxy;

- 20 The malononitrile compounds of formula (X) wherein R⁴ is vinyl and R⁶ is trifluoromethylthio;

The malononitrile compounds of formula (X) wherein R⁴ is vinyl and R⁶ is 1,1,2,2-tetrafluoroethoxy;

- 25 The malononitrile compounds of formula (X) wherein R⁴ is vinyl and R⁶ is chlorine;

The malononitrile compounds of formula (X) wherein R⁴ is vinyl and R⁶ is bromine;

The malononitrile compounds of formula (X) wherein R⁴ is vinyl and

R⁶ is fluorine;

The malononitrile compounds of formula (X) wherein R⁴ is vinyl and
R⁶ is cyano;

The malononitrile compounds of formula (X) wherein R⁴ is vinyl and
5 R⁶ is nitro;

The malononitrile compounds of formula (X) wherein R⁴ is allyl and
R⁶ is trifluoromethyl;

The malononitrile compounds of formula (X) wherein R⁴ is allyl and
R⁶ is difluoromethoxy;

10 The malononitrile compounds of formula (X) wherein R⁴ is allyl and
R⁶ is trifluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is allyl and
R⁶ is trifluoromethylthio;

The malononitrile compounds of formula (X) wherein R⁴ is allyl and
15 R⁶ is 1,1,2,2-tetrafluoroethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is allyl and
R⁶ is chlorine;

The malononitrile compounds of formula (X) wherein R⁴ is allyl and
R⁶ is bromine;

20 The malononitrile compounds of formula (X) wherein R⁴ is allyl and
R⁶ is fluorine;

The malononitrile compounds of formula (X) wherein R⁴ is allyl and
R⁶ is cyano;

The malononitrile compounds of formula (X) wherein R⁴ is allyl and
25 R⁶ is nitro;

The malononitrile compounds of formula (X) wherein R⁴ is ethyl and
R⁶ is trifluoromethyl;

The malononitrile compounds of formula (X) wherein R⁴ is ethyl and

R⁶ is trifluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is ethyl and R⁶ is trifluoromethylthio;

The malononitrile compounds of formula (X) wherein R⁴ is ethyl and
5 R⁶ is chlorine;

The malononitrile compounds of formula (X) wherein R⁴ is ethyl and R⁶ is cyano;

The malononitrile compounds of formula (X) wherein R⁴ is 3-butenyl and R⁶ is trifluoromethyl;

10 The malononitrile compounds of formula (X) wherein R⁴ is 3-butenyl and R⁶ is trifluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is 3-butenyl and R⁶ is trifluoromethylthio;

The malononitrile compounds of formula (X) wherein R⁴ is 3-butenyl
15 and R⁶ is chlorine;

The malononitrile compounds of formula (X) wherein R⁴ is 3-butenyl and R⁶ is cyano;

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-1-propenyl and R⁶ is trifluoromethyl;

20 The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-1-propenyl and R⁶ is trifluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-1-propenyl and R⁶ is trifluoromethylthio;

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-1-propenyl and R⁶ is chlorine;
25

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-1-propenyl and R⁶ is cyano;

The malononitrile compounds of formula (X) wherein R⁴ is 1-propenyl

and R⁶ is trifluoromethyl;

The malononitrile compounds of formula (X) wherein R⁴ is 1-propenyl and R⁶ is trifluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is 1-propenyl
5 and R⁶ is trifluoromethylthio;

The malononitrile compounds of formula (X) wherein R⁴ is 1-propenyl and R⁶ is chlorine;

The malononitrile compounds of formula (X) wherein R⁴ is 1-propenyl and R⁶ is cyano;

10 The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-propyl and R⁶ is trifluoromethyl;

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-propyl and R⁶ is difluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-
15 propyl and R⁶ is trifluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-propyl and R⁶ is trifluoromethylthio;

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-propyl and R⁶ is 1,1,2,2-tetrafluoroethoxy;

20 The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-propyl and R⁶ is chlorine;

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-propyl and R⁶ is bromine;

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-
25 propyl and R⁶ is fluorine;

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-propyl and R⁶ is cyano;

The malononitrile compounds of formula (X) wherein R⁴ is 2-methyl-

propyl and R⁶ is nitro;

The malononitrile compounds of formula (X) wherein R⁴ is 2,2-dimethylpropyl and R⁶ is trifluoromethyl;

5 The malononitrile compounds of formula (X) wherein R⁴ is 2,2-dimethylpropyl and R⁶ is difluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is 2,2-dimethylpropyl and R⁶ is trifluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is 2,2-dimethylpropyl and R⁶ is trifluoromethylthio;

10 The malononitrile compounds of formula (X) wherein R⁴ is 2,2-dimethylpropyl and R⁶ is 1,1,2,2-tetrafluoroethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is 2,2-dimethylpropyl and R⁶ is chlorine;

15 The malononitrile compounds of formula (X) wherein R⁴ is 2,2-dimethylpropyl and R⁶ is bromine;

The malononitrile compounds of formula (X) wherein R⁴ is 2,2-dimethylpropyl and R⁶ is fluorine;

The malononitrile compounds of formula (X) wherein R⁴ is 2,2-dimethylpropyl and R⁶ is cyano;

20 The malononitrile compounds of formula (X) wherein R⁴ is 2,2-dimethylpropyl and R⁶ is nitro;

The malononitrile compounds of formula (X) wherein R⁴ is 1-methylethyl and R⁶ is trifluoromethyl;

25 The malononitrile compounds of formula (X) wherein R⁴ is 1-methylethyl and R⁶ is difluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is 1-methylethyl and R⁶ is trifluoromethoxy;

The malononitrile compounds of formula (X) wherein R⁴ is 1-methyl-

ethyl and R⁶ is trifluoromethylthio;

The malononitrile compounds of formula (X) wherein R⁴ is 1-methyl-ethyl and R⁶ is 1,1,2,2-tetrafluoroethoxy;

5 The malononitrile compounds of formula (X) wherein R⁴ is 1-methyl-ethyl and R⁶ is chlorine;

The malononitrile compounds of formula (X) wherein R⁴ is 1-methyl-ethyl and R⁶ is bromine;

The malononitrile compounds of formula (X) wherein R⁴ is 1-methyl-ethyl and R⁶ is fluorine;

10 The malononitrile compounds of formula (X) wherein R⁴ is 1-methyl-ethyl and R⁶ is cyano;

The malononitrile compounds of formula (X) wherein R⁴ is 1-methyl-ethyl and R⁶ is nitro.

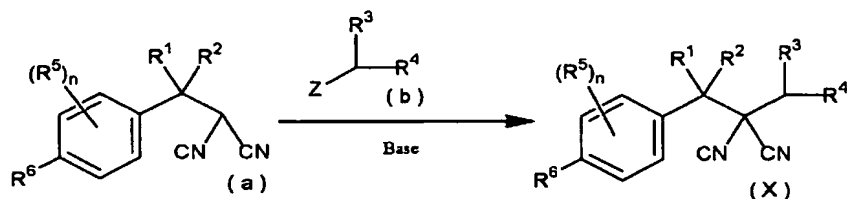
15 The preferred compounds among compound (X) are the compounds wherein R⁶ is halogen, cyano, nitro, C₁-C₄ haloalkyl, C₁-C₄ haloalkyloxy or C₁-C₄ haloalkylthio; the compounds wherein R³ and R⁴ are the same or different and independently C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, or hydrogen, or R³ and R⁴ are taken together to form C₂-C₆ (halo)alkylene; or the compounds wherein n is 1 to 3 and at least one of R⁵ is halogen, cyano, nitro,
20 C₁-C₄ haloalkyl, C₁-C₄ haloalkyloxy or C₁-C₄ (halo)alkylthio. More preferred compounds are the compounds wherein R⁶ is halogen, cyano, nitro, C₁-C₄ fluoroalkyl, C₁-C₄ fluoroalkyloxy or C₁-C₄ fluoroalkylthio; or the compounds wherein n is 1 to 3 and at least one of R⁵ is halogen, cyano, nitro, C₁-C₄ fluoroalkyl, C₁-C₄ fluoroalkyloxy or C₁-C₄ fluoroalkylthio.

25 The following will describe the production processes for compounds (X).

The compounds (X) can be produced by, for example, the following (Production Process 1) to (Production Process 5).

(Production Process 1)

This is a process by reacting compound (a) with compound (b) in the presence of a base.



- 5 wherein R^1 , R^2 , R^3 , R^4 , R^5 , R^6 , and n are as defined above, and Z is halogen, methanesulfonyl, trifluoromethanesulfonyl, or toluenesulfonyl.

The reaction is usually carried out in a solvent. The solvent which can be used in the reaction may include acid amides such as dimethylformamide; ethers such as diethyl ether and tetrahydrofuran; organic sulfur compounds such as dimethylsulfoxide and sulfolane; halogenated hydrocarbons such as 1,2-dichloroethane and chlorobenzene; aromatic hydrocarbons such as toluene and xylene; water; and mixtures thereof.

The base which can be used in the reaction may include inorganic bases such as sodium hydride, sodium hydroxide, potassium hydroxide, and potassium carbonate; alkali metal alkoxides such as sodium methoxide, sodium ethoxide, and potassium tert-butoxide; alkali metal amides such as lithium diisopropylamide; and organic bases such as 4-dimethylaminopyridine, 1,4-diazabicyclo[2.2.2]octane, and 1,8-diazabicyclo[5.4.0]-7-undecene. The amount of base used in the reaction is usually in a ratio of 1 to 10 moles relative to 1 mole of compound (a).

The reaction temperature is usually in the range of -20°C to 100°C .

The reaction time is usually in the range of 1 to 24 hours.

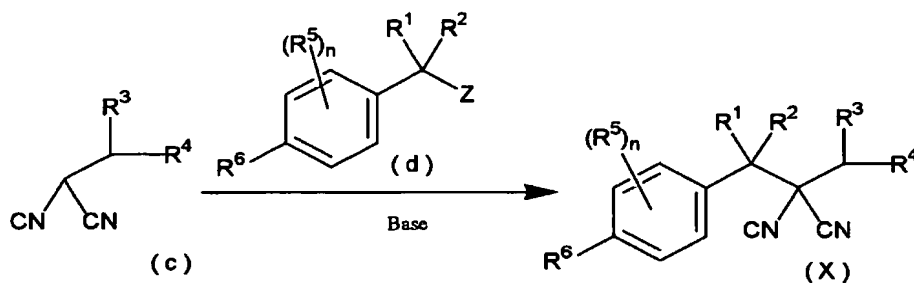
The amount of compound (b) used in the reaction is usually in a ratio of 1 to 10 moles relative to 1 mole of compound (a).

25 After the reaction, the reaction mixture is poured into water, followed

by ordinary post-treatment procedures including extraction with an organic solvent and concentration, thereby isolating the desired compounds, which may be purified by a technique such as chromatography or recrystallization.

(Production Process 2)

- 5 This is a process by reacting compound (c) with compound (d) in the presence of a base.



wherein R^1 , R^2 , R^3 , R^4 , R^5 , R^6 , n , and Z are as defined above.

- 10 The reaction is usually carried out in a solvent. The solvent which can be used in the reaction may include acid amides such as dimethylformamide; ethers such as diethyl ether and tetrahydrofuran; organic sulfur compounds such as dimethylsulfoxide and sulfolane; halogenated hydrocarbons such as 1,2-dichloroethane and chlorobenzene; aromatic hydrocarbons such as toluene and xylene; water; and mixtures thereof.

- 15 The base which can be used in the reaction may include inorganic bases such as sodium hydride, sodium hydroxide, potassium hydroxide, and potassium carbonate; alkali metal alkoxides such as sodium methoxide, sodium ethoxide, and potassium tert-butoxide; alkali metal amides such as lithium diisopropylamide; and organic bases such as 4-dimethylaminopyridine, 1,4-diazabicyclo[2.2.2]octane, and 1,8-diazabicyclo[5.4.0]-7-undecene.
20 The amount of base used in the reaction is usually in a ratio of 1 to 10 moles relative to 1 mole of compound (a).

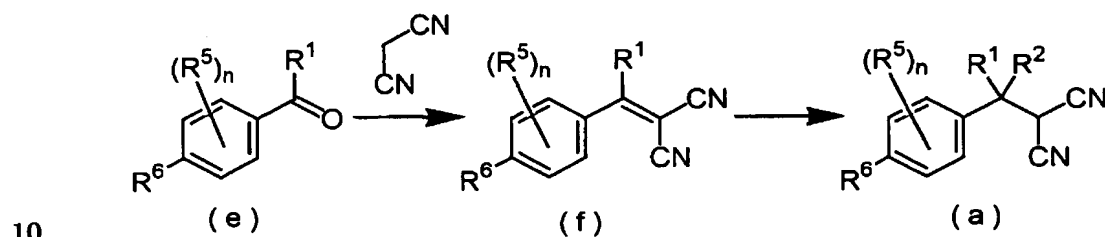
The reaction temperature is usually in the range of -20°C to 100°C .

The reaction time is usually in the range of 1 to 24 hours.

The amount of compound (b) used in the reaction is usually in a ratio of 1 to 10 moles relative to 1 mole of compound (a).

After the reaction, the reaction mixture is poured into water, followed
 5 by ordinary post-treatment procedures including extraction with an organic solvent and concentration, thereby isolating the desired compounds, which may be purified by a technique such as chromatography or recrystallization.

The compound (a) can be produced through a route, for example, as shown in the following scheme.



wherein R^1 , R^2 , R^5 , R^6 , and n are as defined above.

(Step 1)

The compound (f) can be produced by reacting compound (e) with malononitrile.

15 The reaction is usually carried out in a solvent and in the presence of a base. The solvent which can be used in the reaction may include acid amides such as *N,N*-dimethylformamide; ethers such as diethyl ether and tetrahydrofuran; halogenated hydrocarbons such as chloroform, 1,2-dichloroethane, and chlorobenzene; aromatic hydrocarbons such as toluene and
 20 xylene; alcohols such as methanol, ethanol, and isopropanol; and mixtures thereof.

The base which can be used in the reaction may include tetrabutylammonium hydroxide. The amount of base used in the reaction is usually in a ratio of 0.01 to 0.5 mole relative to 1 mole of compound (e).

The amount of malononitrile used in the reaction is usually in a ratio of 1 to 10 moles relative to 1 mole of compound (e).

The reaction temperature is usually in the range of -20°C to 200°C .

The reaction time is usually in the range of 1 to 24 hours.

5 The reaction may be carried out, while removing, if necessary, water which is generated by the reaction, from the reaction system.

After the reaction, the reaction mixture is poured into water, followed by ordinary post-treatment procedures including extraction with an organic solvent and concentration, thereby isolating the desired compounds, which
10 may be purified by a technique such as chromatography or recrystallization.

(Step 2)

(1) The case where R^2 is a substituent other than hydrogen and cyano:

The compound (a) can be produced by reacting compound (f) with an
15 organometallic compound.

The reaction is usually carried out in a solvent and, if necessary, in the presence of a copper salt.

The solvent which can be used in the reaction may include ethers such as diethyl ether and tetrahydrofuran; aromatic hydrocarbons such as
20 toluene and xylene; and mixtures thereof.

The organometallic compound which can be used in the reaction may include organic magnesium compounds such as methyl magnesium iodide, ethyl magnesium bromide, isopropyl magnesium bromide, vinyl magnesium bromide, ethynyl magnesium bromide, and dimethyl magnesium; organic
25 lithium compounds such as methyl lithium; organic zinc compounds such as diethyl zinc; and organic copper compounds such as trifluoromethyl copper. The amount of organometallic compound used in the reaction is usually in a ratio of 1 to 10 moles relative to 1 mole of compound (f).

The copper salt which can be used in the reaction may include copper (I) iodide and copper (I) bromide. The amount of copper salt used in the reaction is usually not greater than 1 mole relative to 1 mole of compound (f).

The reaction temperature is usually in the range of -20°C to 100°C .

5 The reaction time is usually in the range of 1 to 24 hours.

After the reaction, the reaction mixture is poured into water, followed by ordinary post-treatment procedures including extraction with an organic solvent and concentration, thereby isolating the desired compounds, which may be purified by a technique such as chromatography or recrystallization.

10 (2) The case where R^2 is hydrogen:

The compound (a) can be produced by subjecting compound (f) to reduction.

The reduction is usually carried out in a solvent.

15 The solvent which can be used in the reaction may include ethers such as diethyl ether and tetrahydrofuran; aromatic hydrocarbons such as toluene and xylene; alcohols such as methanol, ethanol, and propanol; water; and mixtures thereof.

The reducing agent which can be used in the reaction may include sodium borohydride. The amount of reducing agent used in the reaction is
20 usually in a ratio of 0.25 to 2 moles relative to 1 mole of compound (f).

The reaction time is usually in the range of a moment to 24 hours.

The reaction temperature is usually in the range of 0°C to 50°C .

25 After the reaction, the reaction mixture is poured into water, followed by ordinary post-treatment procedures including extraction with an organic solvent and concentration, thereby isolating the desired compounds, which may be purified by a technique such as chromatography or recrystallization.

(3) The case where R^2 is cyano:

The compound (a) can be produced by reacting compound (f) with a

cyanide.

The solvent which can be used in the reaction may include ethers such as diethyl ether and tetrahydrofuran; aromatic hydrocarbons such as toluene and xylene; and mixtures thereof.

- 5 The cyanide which can be used in the reaction may include tetrabutylammonium cyanide. The amount of cyanide used in the reaction is usually in a ratio of 1 to 10 moles relative to 1 mole of compound (f).

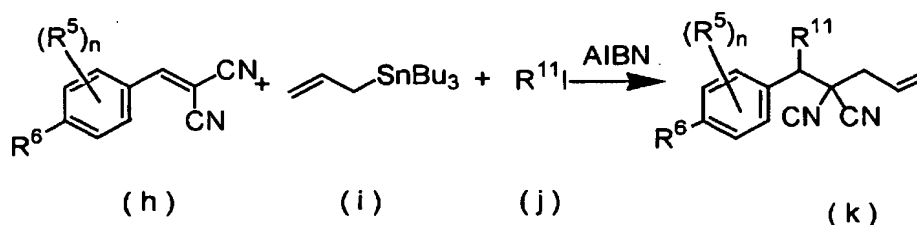
The reaction temperature is usually in the range of -20°C to 100°C .

The reaction time is usually in the range of 1 to 24 hours.

- 10 After the reaction, the reaction mixture is poured into water, followed by ordinary post-treatment procedures including extraction with an organic solvent and concentration, thereby isolating the desired compounds, which may be purified by a technique such as chromatography or recrystallization.

(Production Process 3)

- 15 The compounds wherein R^1 is $\text{C}_1\text{-C}_6$ (halo)alkyl, R^2 and R^3 are both hydrogen, and R^4 is $\text{CH}_2=\text{CH}$ can also be produced by the process as shown in the following scheme.



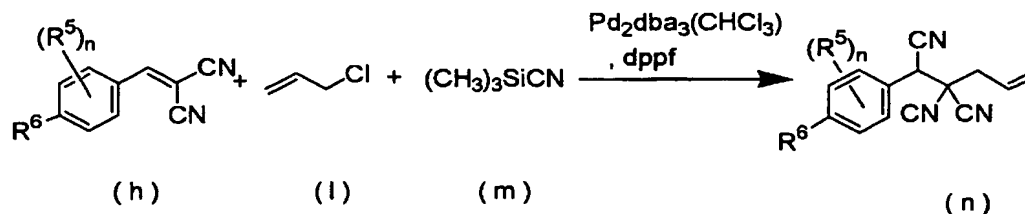
- wherein R^5 , R^6 , and n are as defined above, R^{11} is $\text{C}_1\text{-C}_6$ (halo)alkyl, Bu is butyl, and AIBN is azobisisobutyronitrile.
- 20

The reaction can be carried out according to the process as described in J. Am. Chem. Soc., 110, 1289 (1988).

(Production Process 4)

The compounds wherein R^1 is cyano, R^2 and R^3 are both hydrogen, R^4

is $\text{CH}_2=\text{CH}$ can also be produced by the process as shown in the following scheme.

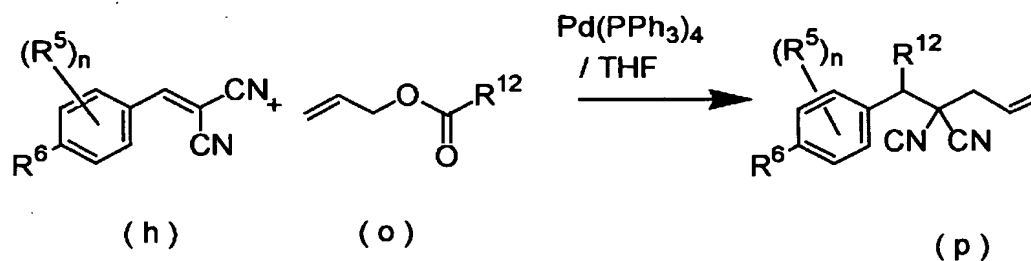


wherein R^5 , R^6 , and n are as defined above, dba is dibenzylideneacetone, and
 5 dppf is 1,1'-bis(diphenylphosphino)ferrocene.

The reaction can be carried out according to the conditions as described in Tetrahedron Lett., 41, 2911 (2000).

(Production Process 5)

The compounds wherein R^1 is $\text{C}_1\text{-C}_6$ (halo)alkyloxy, R^2 and R^3 are both
 10 hydrogen, and R^4 is $\text{CH}_2=\text{CH}$ can also be produced by the process as shown in the following scheme.



wherein R^5 , R^6 , and n are as defined above, R^{12} is $\text{C}_1\text{-C}_6$ (halo)alkyloxy, Ph is phenyl, and THF is tetrahydrofuran.

15 The reaction can be carried out according to the conditions as described in J. Am. Chem. Soc., 120, 6838 (1998).

The pests against which compounds (X) exhibit controlling activity may include insect pests, acarine pests, and nematode pests, specific examples which are as follows:

20 Hemiptera:

Delphacidae such as *Laodelphax striatellus*, *Nilaparvata lugens*, and

Sogatella furcifera;

Deltocephalidae such as *Nephotettix cincticeps* and *Nephotettix virescens*;

Aphididae such as *Aphis gossypii* and *Myzus persicae*;

5 Pentatomidae such as *Nezara antennata*, *Riptortus clavatus*, *Eysarcoris lewisi*, *Eysarcoris parvus*, *Plautia stali* and *Halyomorpha misia*;

Aleyrodidae such as *Trialeurodes vaporariorum* and *Bemisia argentifolii*;

10 Coccidae such as *Aonidiella aurantii*, *Comstockaspis perniciosus*, *Unaspis citri*, *Ceroplastes rubens*, and *Icerya purchasi*;

Tingidae;

Psyllidae;

Lepidoptera:

15 Pyralidae such as *Chilo suppressalis*, *Cnaphalocrocis medinalis*, *Notarcha derogata*, and *Plodia interpunctella*;

Noctuidae such as *Spodoptera litura*, *Pseudaletia separata*, *Thoricoplusia* spp., *Heliothis* spp., and *Helicoverpa* spp.;

Pieridae such as *Pieris rapae*;

20 Tortricidae such as *Adoxophyes* spp., *Grapholita molesta*, and *Cydia pomonella*;

Carposinidae such as *Carposina niponensis*;

Lyonetiidae such as *Lyonetia* spp.;

Lymantriidae such as *Lymantria* spp. and *Euproctis* spp.;

Yponomeutidae such as *Plutella xylostella*;

25 Gelechiidae such as *Pectinophora gossypiella*;

Arctiidae such as *Hyphantria cunea*;

Tineidae such as *Tinea translucens* and *Tineola bisselliella*;

Diptera:

- Calicidae such as *Culex pipiens pallens*, *Culex tritaeniorhynchus*,
and *Culex quinquefasciatus*;
- Aedes spp. such as *Aedes aegypti* and *Aedes albopictus*;
- Anopheles spp. such as *Anopheles sinensis*;
- 5 Chironomidae;
- Muscidae such as *Musca domestica* and *Muscina stabulans*;
- Calliphoridae;
- Sarcophagidae;
- Fanniidae;
- 10 Anthomyiidae such as *Delia platura* and *Delia antiqua*;
- Tephritidae;
- Drosophilidae;
- Psychodidae;
- Simuliidae;
- 15 Tabanidae;
- Stomoxyidae;
- Agromyzidae;
- Coleoptera:
- Diabrotica spp. such as *Diabrotica virgifera* and *Diabrotica undecim-*
20 *punctata howardi*;
- Scarabaeidae such as *Anomala cuprea* and *Anomala rufocuprea*;
- Curculionidae such as *Sitophilus zeamais*, *Lissorhoptrus oryzophilus*,
and *Callosobruchus chienensis*;
- Tenebrionidae such as *Tenebrio molitor* and *Tribolium castaneum*;
- 25 Chrysomelidae such as *Oulema oryzae*, *Aulacophora femoralis*, *Phyl-*
lotreta striolata, and *Leptinotarsa decemlineata*;
- Anobiidae;
- Epilachna spp. such as *Epilachna vigintioctopunctata*;

- Lyctidae;
Bostrychidae;
Cerambycidae;
Paederus fuscipes;
5 Dictyoptera:
Blattella germanica, *Periplaneta fuliginosa*, *Periplaneta americana*,
Periplaneta brunnea, and *Blatta orientalis*;
Thysanoptera:
Thrips palmi, *Thrips tabaci*, *Frankliniella occidentalis*, *Frankliniella*
10 *intonsa*;
Hymenoptera:
Formicidae;
Vespidae;
Bethylidae;
15 Tenthredinidae such as *Athalia japonica*;
Orthoptera:
Gryllotalpidae;
Acrididae;
Siphonaptera:
20 *Ctenocephalides felis*, *Ctenocephalides canis*, *Pulex irritans*, *Xenopsylla cheopis*;
Anoplura:
Pediculus humanus corporis, *Phthirus pubis*, *Haematopinus eurysternus*, and *Dalmalinia ovis*;
25 Isoptera:
Reticulitermes speratus and *Coptotermes formosanus*;
Acarina:
Tetranychidae such as *Tetranychus urticae*, *Tetranychus kanzawai*,

- Panonychus citri*, *Panonychus ulmi*, and *Oligonychus* spp.;
- Eriophyidae such as *Aculops pelekassi* and *Aculus schlechtendali*;
- Tarsonemidae such as *Polyphagotarsonemus latus*;
- Tenuipalpidae;
- 5 Tuckerellidae;
- Ixodidae such as *Haemaphysalis longicornis*, *Haemaphysalis flava*,
Dermacentor taiwanicus, *Ixodes ovatus*, *Ixodes persulcatus*, and *Boophilus microplus*;
- Acaridae such as *Tyrophagus putrescentiae*;
- 10 Epidermoptidae such as *Dermatophagoides farinae* and *Dermatophagoides ptrehyssnus*;
- Cheyletidae such as *Cheyletus eruditus*, *Cheyletus malaccensis*, and
Cheyletus moorei;
- Dermanyssidae;
- 15 Arachnida:
- Chiracanthium japonicum* and *Latrodectus hasseltii*;
- Chilopoda:
- Thereuonema hilgendorfi* and *Scolopendra subspinipes*;
- Diplopoda:
- 20 *Oxidus gracilis* and *Nedyopus tambanus*;
- Isopoda:
- Armadillidium vulgare*;
- Gastropoda:
- Limax marginatus* and *Limax flavus*;
- 25 Nematoda:
- Pratylenchus coffeae*, *Pratylenchus fallax*, *Heterodera glycines*, *Globodera rostochiensis*, *Meloidogyne hapla*, and *Meloidogyne incognita*.

When compounds (X) are used as the active ingredients of pesticide

compositions, they may be used as such without addition of any other ingredients. However, they are usually used in admixture with solid carriers, liquid carriers and/or gaseous carriers, and if necessary, by addition of adjuvants such as surfactants, followed by formulation into various forms such as emulsifiable concentrates, oil formulations, flowables, dusts, wettable powders, granules, paste formulations, microcapsule formulations, foams, aerosol formulations, carbon dioxide gas formulations, tablets, or resin formulations. These formulations may be used by processing into poison baits, shampoo, mosquito coils, electric mosquito mats, smokes, fumigants, or sheets.

In these formulations, compounds (X) are usually contained each in an amount of 0.1% to 95% by weight.

The solid carrier which can be used in the formulation may include the following materials in fine powder or granular form: clays (*e.g.*, kaolin clay, diatomaceous earth, bentonite, Fubasami clay, acid clay); talc, ceramic, and other inorganic minerals (*e.g.*, sericite, quartz, sulfur, activated carbon, calcium carbonate, hydrated silica); and chemical fertilizers (*e.g.*, ammonium sulfate, ammonium phosphate, ammonium nitrate, ammonium chloride, urea).

The liquid carrier may include aromatic or aliphatic hydrocarbons (*e.g.*, xylene, toluene, alkylnaphthalene, phenylxylylethane, kerosine, light oils, hexane, cyclohexane); halogenated hydrocarbons (*e.g.*, chlorobenzene, dichloromethane, dichloroethane, trichloroethane); alcohols (*e.g.*, methanol, ethanol, isopropyl alcohol, butanol, hexanol, ethylene glycol); ethers (*e.g.*, diethyl ether, ethylene glycol dimethyl ether, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, propylene glycol monomethyl ether, tetrahydrofuran, dioxane); esters (*e.g.*, ethyl acetate, butyl acetate); ketones (*e.g.*, acetone, methyl ethyl ketone, methyl isobutyl ketone, cyclohexanone);

nitriles (acetonitrile, isobutyronitrile); sulfoxides (*e.g.*, dimethylsulfoxide); acid amides (*e.g.*, N,N-dimethylformamide, N,N-dimethylacetamide); vegetable oils (*e.g.*, soy bean oil and cotton seed oil); plant essential oils (*e.g.*, orange oil, hyssop oil, lemon oil); and water.

5 The gaseous carrier may include butane gas, Freon gas, liquefied petroleum gas (LPG), dimethyl ether, and carbon dioxide.

 The surfactant may include alkyl sulfate salts; alkylsulfonic acid salts; alkylarylsulfonic acid salts; alkyl aryl ethers and their polyoxyethylene derivatives; polyethylene glycol ethers; polyol esters; and sugar alcohol derivatives.
10

 The other adjuvants may include binders, dispersants, and stabilizers, specific examples of which are casein, gelatin, polysaccharides (*e.g.*, starch, gum arabic, cellulose derivatives, alginic acid), lignin derivatives, bentonite, sugars, synthetic water-soluble polymers (*e.g.*, polyvinyl alcohol, polyvinylpyrrolidone, polyacrylic acid), PAP (isopropyl acid phosphate), BHT (2,6-di-*t*-butyl-4-methylphenol), BHA (mixtures of 2-*t*-butyl-4-methoxyphenol and 3-*t*-butyl-4-methoxyphenol), vegetable oils, mineral oils, fatty acids, and fatty acid esters.
15

 The base material for resin formulations may include vinyl chloride polymers and polyurethanes. These base materials may contain, if necessary, plasticizers such as phthalic acid esters (*e.g.*, dimethyl phthalate, dioctyl phthalate), adipic acid esters, and stearic acid. The resin formulations can be obtained by kneading the compounds into the base materials with an ordinary kneader and subsequent forming such as injection molding, extrusion, or pressing. They can be processed, if necessary, though further forming and cutting into resin formulations in various shapes such as plates, films, tapes, nets, or strings. These resin formulations are processed as, for example, collars for animals, ear tags for animals, sheet formulations, at-
20
25

tractive strings, or poles for horticultural use.

The base material for poison baits may include grain powders, vegetable oils, sugars, and crystalline cellulose. If necessary, additional agents may be added, including antioxidants such as dibutylhydroxytoluene and
5 nordihydroguaiaretic acid; preservatives such as dehydroacetic acid; agents for preventing children and pets from erroneously eating, such as hot pepper powder; and pest-attractive flavors such as cheese flavor, onion flavor, and peanut oil.

The pesticide compositions of the present invention may be used by,
10 for example, direct application to pests and/or application to the habitats of pests (*e.g.*, plant bodies, animal bodies, soil).

When the pesticide compositions of the present invention are used for the control of pests in agriculture and forestry, their application amounts are usually 1 to 10,000 g/ha, preferably 10 to 500 g/ha. Formulations such as
15 emulsifiable concentrates, wettable powders, flowables, and microcapsule formulations are usually used after dilution with water to have an active ingredient concentration of 1 to 1000 ppm, while formulations such as dusts and granules are usually used as such. These formulations may be directly applied to plants to be protected from pests. These formulations can also be
20 incorporated into soil for the control of pests inhabiting the soil, or can also be applied to beds before planting or applied to planting holes or plant bottoms in the planting. Further, the pesticide compositions of the present invention in the form of sheet formulations can be applied by the methods in which the sheet formulations are wound around plants, disposed in the vicinity of plants, or laid on the soil surface at the plant bottoms.
25

When the pesticide compositions of the present invention are used for the prevention of epidemics, their application amounts as active ingredient amounts are usually 0.001 to 10 mg/m³ for spatial application or 0.001 to 100

mg/m² for planar application. Formulations such as emulsifiable concentrates, wettable powders, and flowables are usually applied after dilution with water to have an active ingredient concentration of 0.01 to 10,000 ppm, while formulations such as oil formulations, aerosols, smokes, or poison baits
5 are usually applied as such.

When the pesticide compositions of the present invention are used for the control of external parasites on domestic animals such as cattle, sheep, goat, and fowl or small animals such as dogs, cats, rats, and mice, they can be used by the veterinarily well-known methods. As the specific methods of
10 use, administration is achieved by, for example, tablets, feed incorporation, suppositories, or injections (*e.g.*, intramuscular, subcutaneous, intravenous, intraperitoneal) for systemic control, or by, for example, spraying, pour-on treatment, or spot-on treatment with an oil formulation or an aqueous solution, washing animals with a shampoo formulation, or attachment of a collar
15 or ear tag prepared from a resin formulation to animals for non-systemic control. The amounts of compounds (X) when administered to animal bodies are usually in the range of 0.1 to 1000 mg per 1 kg weight of each animal.

The pesticide compositions of the present invention can also be used in admixture or combination with other insecticides, nematocides, acaricides,
20 bactericides, fungicides, herbicides, plant growth regulators, synergists, fertilizers, soil conditioners, animal feeds, and the like.

Examples of the insecticides and acaricides include organophosphorus compounds such as fenitrothion [O,O-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate], fenthion [O,O-dimethyl O-(3-methyl-4-(methythio)phenyl) phosphorothioate], diazinon [O,O-diethyl O-2-isopropyl-6-methylpyrimidin-4-yl phosphorothioate], chlorpyrifos [O,O-diethyl O-3,5,6-trichloro-2-pyridyl phosphorothioate], DDVP [2,2-dichlorovinyl dimethyl phosphate], cyanophos [O-4-cyanophenyl O,O-dimethyl phosphorothioate],
25

dimethoate [O,O-dimethyl S-(N-methylcarbamoylmethyl) dithiophosphate],
 phenthoate [ethyl 2-dimethoxyphosphinothioylthio(phenyl)acetate], mala-
 thion [diethyl (dimethoxyphosphinothioylthio)succinate], and azinphos-
 methyl [S-3,4-dihydro-4-oxo-1,2,3-benzotriazin-3-ylmethyl O,O-dimethyl
 5 phosphorodithioate]; carbamate compounds such as BPMC (2-sec-butyl-
 phenyl methylcarbamate), benfracarb [ethyl N-[2,3-dihydro-2,2-dimethyl-
 benzofuran-7-yloxycarbonyl (methyl)aminothio]-N-isopropyl- β -alaninate],
 propoxur [2-isopropoxyphenyl N-methylcarbamate] and carbaryl [1-naphthyl
 N-methylcarbamate]; pyrethroid compounds such as etofenprox [2-(4-
 10 ethoxyphenyl)-2-methylpropyl-3-phenoxybenzyl ether], fenvalerate [(RS)- α -
 cyano-3-phenoxybenzyl (RS)-2-(4-chlorophenyl)-3-methyl-butyrate], esfen-
 valerate [(S)- α -cyano-3-phenoxybenzyl (S)-2-(4-chlorophenyl)-3-methyl-
 butyrate], fenpropathrin [(RS)- α -cyano-3-phenoxybenzyl 2,2,3,3-tetra-
 methylcyclopropanecarboxylate], cypermethrin [(RS)- α -cyano-3-phenoxy-
 15 benzyl (1RS)-cis,trans-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecar-
 boxylate], permethrin [3-phenoxybenzyl (1RS)-cis, trans-3-(2,2-dichloro-
 vinyl)-2,2-dimethylcyclopropanecarboxylate], cyhalothrin [(RS)- α -cyano-3-
 phenoxybenzyl (Z)-(1RS)-cis-3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-di-
 methylcyclopropanecarboxylate], deltamethrin [(S)- α -cyano-3-phenoxy-
 20 benzyl (1R)-cis-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropane-carboxylate],
 cycloprothrin [(RS)- α -cyano-3-phenoxybenzyl (RS)-2,2-dichloro-1-(4-ethoxy-
 phenyl)cyclopropanecarboxylate], fluvalinate [α -cyano-3-phenoxybenzyl N-
 (2-chloro- α,α,α -trifluoro-p-tolyl)-D-valinate], bifenthrin [2-methylbiphenyl-3-
 ylmethyl (Z)-(1RS)-cis-3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethyl-
 25 cyclopropanecarboxylate], 2-methyl-2-(4-bromodifluoro-methoxyphenyl)-
 propyl 3-phenoxybenzyl ether, tralomethrin [(S)- α -cyano-3-phenoxybenzyl
 (1R-cis)-3-((1RS)(1,2,2,2-tetrabromoethyl))-2,2-dimethyl-cyclopropanecarbox-
 ylate], silafluofen [(4-ethoxyphenyl){3-(4-fluoro-3-phenoxyphenyl)propyl}-

dimethylsilane], d-phenothrin [3-phenoxybenzyl (1R-cis,trans)-chrysanthemate], cyphenothrin [(RS)- α -cyano-3-phenoxybenzyl (1R-cis,trans)-chrysanthemate], d-resmethrin [5-benzyl-3-furylmethyl (1R-cis,trans)-chrysanthemate], acrinathrin [(S)- α -cyano-3-phenoxybenzyl (1R,cis(Z))-2,2-dimethyl-3-{3-oxo-3-(1,1,1,3,3,3-hexafluoropropoxy)propenyl}cyclopropanecarboxylate], cyfluthrin [(RS)- α -cyano-4-fluoro-3-phenoxybenzyl 3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate], tefluthrin [2,3,5,6-tetrafluoro-4-methylbenzyl (1RS-cis(Z))-3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate], transfluthrin [2,3,5,6-tetrafluorobenzyl (1R-trans)-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate], tetramethrin [3,4,5,6-tetrahydrophthalimidomethyl (1RS)-cis,trans-chrysanthemate], allethrin [(RS)-3-allyl-2-methyl-4-oxocyclopent-2-enyl (1RS)-cis,trans-chrysanthemate], prallethrin [(S)-2-methyl-4-oxo-3-(2-propynyl)cyclopent-2-enyl (1R)-cis,trans-chrysanthemate], empenethrin [(RS)-1-ethynyl-2-methyl-2-pentenyl (1R)-cis,trans-chrysanthemate], imiprothrin [2,5-dioxo-3-(prop-2-ynyl)imidazolidin-1-ylmethyl (1R)-cis,trans-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate], d-furamethrin [5-(2-propynyl) furfuryl (1R)-cis,trans-chrysanthemate] and 5-(2-propynyl)furfuryl 2,2,3,3-tetramethylcyclopropanecarboxylate; neonicotinoid derivatives such as N-cyano-N'-methyl-N'-(6-chloro-3-pyridylmethyl) acetamidine; nitenpyram [N-(6-chloro-3-pyridylmethyl)-N-ethyl-N'-methyl-2-nitrovinyldenediamine]; thiacloprid [1-(2-chloro-5-pyridylmethyl)-2-cyanoiminothiazoline]; thiamethoxam [3-((2-chloro-5-thiazolyl)methyl)-5-methyl-4-nitroiminotetrahydro-1,3,5-oxadiazine], 1-methyl-2-nitro-3-((3-tetrahydrofuryl)methyl)-guanidine and 1-(2-chloro-5-thiazolyl)methyl-3-methyl-2-nitroguanidine; nitroiminohexahydro-1,3,5-triazine derivatives; chlorinated hydrocarbons such as endosulfan [6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepine oxide], γ -BHC [1,2,3,4,5,6-hexachloro-

cyclohexane] and 1,1-bis(chlorophenyl)-2,2,2-trichloroethanol; benzoyl-phenylurea compounds such as chlorfluazuron [1-(3,5-dichloro-4-(3-chloro-5-trifluoromethylpyridin-2-yloxy)phenyl)-3-(2,6-difluorobenzoyl)urea], teflubenzuron [1-(3,5-dichloro-2,4-difluorophenyl)-3-(2,6-difluorobenzoyl)urea]
5 and flufenoxuron [1-(4-(2-chloro-4-trifluoromethylphenoxy)-2-fluorophenyl)-3-(2,6-difluorobenzoyl)urea]; juvenile hormone like compounds such as pyriproxyfen [4-phenoxyphenyl 2-(2-pyridyloxy)propyl ether], methoprene [isopropyl (2E,4E)-11-methoxy-3,7,11-trimethyl-2,4-dodecadienoate] and hydro-
prene [ethyl (2E,4E)-11-methoxy-3,7,11-trimethyl-2,4-dodecadienoate]; thio-
10 urea derivatives such as diafenthiuron [N-(2,6-diisopropyl-4-phenoxyphenyl)-N'-tert-butylcarbodiimide]; phenylpyrazole compounds; 4-bromo-2-(4-chlorophenyl)-1-ethoxymethyl-5-trifluoromethylpyrrol-3-carbonitrile [chlorfenapil]; metoxadiazone [5-methoxy-3-(2-methoxyphenyl)-1,3,4-oxadiazol-
2(3H)-one], bromopropylate [isopropyl 4,4'-dibromobenzilate], tetradifon [4-
15 chlorophenyl 2,4,5-trichlorophenyl sulfone], chinomethionat [S,S-6-methylquinoxaline-2,3-diylthiocarbonate], pyridaben [2-tert-butyl-5-(4-tert-butylbenzylthio)-4-chloropyridazin-3(2H)-one], fenpyroximate [tert-butyl
(E)-4-[(1,3-dimethyl-5-phenoxy-pyrazol-4-yl)methyleneaminooxymethyl]benzoate], tebufenpyrad [N-(4-tert-butylbenzyl)-4-chloro-3-ethyl-1-methyl-5-
20 pyrazolecarboxamide], polynactins complex [tetranactin, dinactin and trinactin], pyrimidifen [5-chloro-N-[2-{4-(2-ethoxyethyl)-2,3-dimethylphenoxy}ethyl]-6-ethylpyrimidin-4-amine], milbemectin, abamectin, ivermectin and azadirachtin [AZAD]. Examples of the synergists include bis-(2,3,3,3-tetrachloropropyl) ether (S-421), N-(2-ethylhexyl)bicyclo[2.2.1]hept-5-ene-
25 2,3-dicarboximide (MGK-264) and α -[2-(2-butoxyethoxy)ethoxy]-4,5-methylenedioxy-2-propyltoluene (piperonyl butoxide).

The present invention will further be illustrated by the following production examples, formulation examples, and test examples; however, the

present invention is not limited only to these examples. In the formulation examples, the compound numbers are those shown in Table 1 below.

The following will describe some production examples for compounds (X).

5 Production Example 1

First, 0.20 g of (4-chlorobenzyl)malononitrile was dissolved in 5 ml of N,N-dimethylformamide, to which 46 mg of sodium hydride (60% in oil) was added, while stirring under ice cooling. After the evolution of hydrogen gas ceased, while stirring under ice cooling, 0.44 ml of allyl bromide was added
10 dropwise, followed by further stirring at room temperature overnight. Then, 10% hydrochloric acid was added to the reaction mixture, which was extracted with diethyl ether. The organic layer was successively washed with 10% hydrochloric acid, a saturated aqueous sodium chloride solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced
15 pressure. The residue was subjected to silica gel column chromatography to give 0.13 g of 2-allyl-2-(4-chlorobenzyl)malononitrile (compound 1).

Yield: 54%;

$n_D^{22.0}$: 1.5326.

Production Example 2

20 Using 0.60 g of (1-(4-chlorophenyl)-1-methylethyl)malononitrile, 10 ml of N,N-dimethylformamide, 121 mg of sodium hydride (60% in oil), and 1.20 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 0.60 g of 2-allyl-2-(1-(4-chlorophenyl)-1-methylethyl)malononitrile (compound 2).

25 Yield: 85%;

$n_D^{23.5}$: 1.5354.

Production Example 3

Using 0.36 g of (1-(4-chlorophenyl)-2-methylpropyl)malononitrile, 5

ml of N,N-dimethylformamide, 75 mg of sodium hydride (60% in oil), and 0.20 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 0.29 g of 2-allyl-2-(1-(4-chlorophenyl)-2-methylpropyl)malononitrile (compound 3).

5 Yield: 69%;
 n_D^{25} : 1.5272.

Production Example 4

Using 0.50 g of (4-chlorobenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 126 mg of sodium hydride (60% in oil), and 0.40 ml of 4-bromo-1-
10 butene, and according to the process described in the Production Example 1, there was obtained 0.46 g of 2-(3-butenyl)-2-(4-chlorobenzyl)malononitrile (compound 4).

Yield: 72%;
m.p.: 63.7°C.

15 Production Example 5

Using 1.12 g of (4-(trifluoromethyl)benzyl)malononitrile, 10 ml of N,N-dimethylformamide, 0.24 g of sodium hydride (60% in oil), and 0.63 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 0.58 g of 2-allyl-2-(4-(trifluoromethyl)ben-
20 zyl)malononitrile (compound 5).

Yield: 44%;
m.p.: 80.2°C.

Production Example 6

Using 0.50 g of (4-cyanobenzyl)malononitrile, 5 ml of N,N-dimethyl-
25 formamide, 132 mg of sodium hydride (60% in oil), and 0.42 ml of 4-bromo-1-butene, and according to the process described in the Production Example 1, there was obtained 0.19 g of 2-(3-butenyl)-2-(4-cyanobenzyl)malononitrile (compound 6).

Yield: 29%;

m.p.: 109.4°C.

Production Example 7

Using 0.50 g of (4-cyanobenzyl)malononitrile, 5 ml of N,N-dimethyl-
5 formamide, 132 mg of sodium hydride (60% in oil), and 0.49 ml of 5-bromo-1-
pentene, and according to the process described in the Production Example 1,
there was obtained 0.12 g of 2-(4-cyanobenzyl)-2-(4-pentenyl)malononitrile
(compound 7).

Yield: 17%;

10 m.p.: 91.5°C.

Production Example 8

Using 0.20 g of (2-chlorobenzyl)malononitrile, 5 ml of N,N-dimethyl-
formamide, 46 mg of sodium hydride (60% in oil), and 0.44 ml of allyl
bromide, and according to the process described in the Production Example 1,
15 there was obtained 0.18 g of 2-allyl-2-(2-chlorobenzyl)malononitrile (com-
pound 8).

Yield: 74%;

$n_D^{20.5}$: 1.5329.

Production Example 9

20 Using 0.50 g of (4-chlorobenzyl)malononitrile, 5 ml of N,N-dimethyl-
formamide, 160 mg of sodium hydride (60% in oil), and 0.68 ml of cyclohexyl
iodide, and according to the process described in the Production Example 1,
there was obtained 0.20 g of 2-(4-chlorobenzyl)-2-cyclohexylmalononitrile
(compound 9).

25 Yield: 28%;

m.p.: 107.9°C.

Production Example 10

Using 0.56 g of (1-(4-chlorophenyl)ethyl)malononitrile, 5 ml of N,N-

dimethylformamide, 160 mg of sodium hydride (60% in oil), and 0.56 ml of 4-bromo-1-butene, and according to the process described in the Production Example 1, there was obtained 0.23 g of 2-(3-butenyl)-2-(1-(4-chlorophenyl)-ethyl)malononitrile (compound 10).

5 Yield: 32%;

$n_D^{26.5}$: 1.5259.

Production Example 11

Using 0.50 g of (4-(trifluoromethoxy)benzyl)malononitrile, 5 ml of N,N-dimethylformamide, 123 mg of sodium hydride, and 0.35 ml of allyl
10 bromide, and according to the process described in the Production Example 1, there was obtained 0.26 g of 2-allyl-2-(4-(trifluoromethoxy)benzyl)malononitrile (compound 11).

Yield: 45%;

$n_D^{24.5}$: 1.4682.

15 Production Example 12

Using 0.77 g of (1-(4-(trifluoromethoxy)phenyl)-2-methylpropyl)malononitrile, 5 ml of N,N-dimethylformamide, 160 mg of sodium hydride (60% in oil), and 0.55 ml of 4-bromo-1-butene, and according to the process described
in the Production Example 1, there was obtained 0.30 g of 2-(3-butenyl)-2-
20 (1-(4-(trifluoromethoxyphenyl)-2-methylpropyl)malononitrile (compound 12).

Yield: 33%;

$n_D^{25.5}$: 1.4686.

Production Example 13

Using 2.35 g of (4-bromobenzyl)malononitrile, 50 ml of N,N-dimethylformamide, 0.44 g of sodium hydride (60% in oil), and 4.23 ml of allyl
25 bromide, and according to the process described in the Production Example 1, there was obtained 2.33 g of 2-allyl-2-(4-bromobenzyl)malononitrile (compound 13).

Yield: 85%;

m.p.: 61.7°C.

Production Example 14

Using 1.81 g of (4-cyanobenzyl)malononitrile, 50 ml of N,N-dimethyl-
5 formamide, 0.44 g of sodium hydride (60% in oil), and 4.23 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 1.04 g of 2-allyl-2-(4-cyanobenzyl)malononitrile (compound 14).

Yield: 47%;

10 m.p.: 81.9°C.

Production Example 15

Using 0.23 g of (4-(trifluoromethoxy)benzyl)malononitrile, 5 ml of N,N-dimethylformamide, 60 mg of sodium hydride (60% in oil), and 0.20 ml of 4-bromo-1-butene, and according to the process described in the Production
15 Example 1, there was obtained 0.16 g of 2-(3-butenyl)-2-(4-(trifluoromethoxy)benzyl)malononitrile (compound 15).

Yield: 54%;

$n_D^{25.5}$: 1.4657.

Production Example 16

20 Using 0.76 g of (1-(4-(trifluoromethoxy)phenyl)ethyl)malononitrile, 5 ml of N,N-dimethylformamide, 180 mg of sodium hydride (60% in oil), and 0.61 ml of 4-bromo-1-butene, and according to the process described in the Production Example 1, there was obtained 0.36 g of 2-(3-butenyl)-2-(1-(4-(trifluoromethoxy)phenyl)ethyl)malononitrile (compound 16).

25 Yield: 39%;

$n_D^{25.5}$: 1.4673.

Production Example 17

Using 0.20 g of (3-chlorobenzyl)malononitrile, 5 ml of N,N-dimethyl-

formamide, 46 mg of sodium hydride (60% in oil), and 0.44 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 0.11 g of 2-allyl-2-(3-chlorobenzyl)malononitrile (compound 17).

5 Yield: 45%;
 $n_D^{21.5}$: 1.5302.

Production Example 18

Using 1.74 g of (4-fluorobenzyl)malononitrile, 50 ml of N,N-dimethylformamide, 0.44 g of sodium hydride (60% in oil), and 4.23 ml of allyl
10 bromide, and according to the process described in the Production Example 1, there was obtained 2.00 g of 2-allyl-2-(4-fluorobenzyl)malononitrile (compound 18).

Yield: 93%;
 $n_D^{24.5}$: 1.5028.

15 Production Example 19

Using 0.50 g of (4-chlorobenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.12 g of sodium hydride (60% in oil), and 0.33 ml of isobutyl iodide, and according to the process described in the Production Example 1, there was obtained 0.42 g of 2-(4-chlorobenzyl)-2-isobutylmalononitrile (com-
20 pound 19).

Yield: 65%;
m.p.: 73.2°C.

Production Example 20

Using 0.50 g of (2-methoxybenzyl)malononitrile, 10 ml of N,N-dimethylformamide, 0.12 g of sodium hydride (60% in oil), and 1.1 ml of allyl
25 bromide, and according to the process described in the Production Example 1, there was obtained 0.50 g of 2-allyl-2-(2-methoxybenzyl)malononitrile (compound 20).

Yield: 83%;

$n_D^{18.5}$: 1.5231.

Production Example 21

Using 0.50 g of (4-chlorobenzyl)malononitrile, 5 ml of N,N-dimethyl-
5 formamide, 0.126 g of sodium hydride (60% in oil), and 0.47 ml of 5-bromo-1-
pentene, and according to the process described in the Production Example 1,
there was obtained 0.49 g of 2-(4-chlorobenzyl)-2-(4-pentenyl)malononitrile
(compound 21).

Yield: 72%;

10 $n_D^{22.0}$: 1.5244.

Production Example 22

Using 0.50 g of (4-chlorobenzyl)malononitrile, 5 ml of N,N-dimethyl-
formamide, 0.126 g of sodium hydride (60% in oil), and 0.40 g of 3-chloro-1-
butene, and according to the process described in the Production Example 1,
15 there was obtained 0.35 g of 2-(4-chlorobenzyl)-2-(1-methyl-2-propenyl)-
malononitrile (compound 22).

Yield: 55%;

$n_D^{22.5}$: 1.5284.

Production Example 23

20 Using 2.25 g of (3,4-dichlorobenzyl)malononitrile, 50 ml of N,N-di-
methylformamide, 0.48 g of sodium hydride (60% in oil), and 1.30 ml of allyl
bromide, and according to the process described in the Production Example 1,
there was obtained 1.96 g of 2-allyl-2-(3,4-dichlorobenzyl)malononitrile
(compound 23).

25 Yield: 74%;

m.p.: 71.8°C.

Production Example 24

Using 1.13 g of (2,4-dichlorobenzyl)malononitrile, 20 ml of N,N-di-

methylformamide, 0.24 g of sodium hydride (60% in oil), and 0.63 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 0.78 g of 2-allyl-2-(2,4-dichlorobenzyl)malononitrile (compound 24).

5 Yield: 59%;

$n_D^{24.5}$: 1.5447

Production Example 25

Using 0.50 g of (4-chlorobenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.16 g of sodium hydride (60% in oil), and 0.60 ml of 1-bromo-3-
10 methyl-2-butene, and according to the process described in the Production Example 1, there was obtained 0.52 g of 2-(4-chlorobenzyl)-2-(3-methyl-2-butenyl)malononitrile (compound 25).

Yield: 77%;

$n_D^{25.5}$: 1.5263.

15 Production Example 26

Using 0.80 g of (1-(4-chlorophenyl)-2-methylpropyl)malononitrile, 10 ml of N,N-dimethylformamide, 0.21 g of sodium hydride (60% in oil), and 0.70 ml of 4-bromo-1-butene, and according to the process described in Production Example 1, there was obtained 0.32 g of 2-(3-butenyl)-2-(1-(4-chloro-
20 phenyl)-2-methylpropyl)malononitrile (compound 26).

Yield: 32%;

$n_D^{25.5}$: 1.5217.

Production Example 27

Using 0.20 g of (4-(trifluoromethoxy)benzyl)malononitrile, 5 ml of
25 N,N-dimethylformamide, 50 mg of sodium hydride (60% in oil), and 0.19 ml of 1-bromo-3-methyl-2-butene, and according to the process described in Production Example 1, there was obtained 0.19 g of 2-(3-methyl-2-butenyl)-2-(4-(trifluoromethoxy)benzyl)malononitrile (compound 27).

Yield: 74%;

$n_D^{24.5}$: 1.4707.

Production Example 28

Using 0.50 g of (3-methoxybenzyl)malononitrile, 10 ml of N,N-di-
5 methylformamide, 0.12 g of sodium hydride (60% in oil), and 1.1 ml of allyl
bromide, and according to the process described in the Production Example 1,
there was obtained 0.45 g of 2-allyl-2-(3-methoxybenzyl)malononitrile (com-
pound 28).

Yield: 74%;

10 $n_D^{22.0}$: 1.5238.

Production Example 29

Using 0.50 g of (4-methoxybenzyl)malononitrile, 10 ml of N,N-di-
methylformamide, 0.12 g of sodium hydride (60% in oil), and 1.1 ml of allyl
bromide, and according to the process described in the Production Example 1,
15 there was obtained 0.50 g of 2-allyl-2-(4-methoxybenzyl)malononitrile (com-
pound 29).

Yield: 83%;

$n_D^{22.0}$: 1.5252.

Production Example 30

20 First, 0.24 g of (4-(trifluoromethoxy)benzylidene)malononitrile, 0.66
g of allyltributyltin, and 0.71 g of methyl iodide were dissolved in 10 ml of
benzene, and the solution was heated to the reflux temperature. Then, 40
mg of azobis(isobutyronitrile) was added, and the mixture was stirred for 13
hours, while heating under reflux. The reaction mixture is poured into a
25 mixture of 40 ml of hexane and 40 ml of acetonitrile, followed by phase sepa-
ration. The acetonitrile layer was concentrated, and the resulting residue
was subjected to silica gel thin layer chromatography to give 0.19 g of 2-
allyl-2-(1-(4-(trifluoromethoxy)phenyl)ethyl)malononitrile (compound 30).

Yield: 65%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.68 (3H, d), 2.42-2.61 (2H, m), 3.25 (1H, q), 5.23-5.44 (2H, m), 5.83-5.94 (1H, m), 7.25 (2H, d), 7.40 (2H, d).

Production Example 31

5 Using 0.24 g of (4-(trifluoromethoxy)benzylidene)malononitrile, 10 ml of benzene, 0.66 g of allyltributyltin, 0.89 g of chloriodomethane, and 66 mg of azobis(isobutyronitrile), and according to the process described in Production Example 30, there was obtained 0.20 g of 2-allyl-2-(1-(4-(trifluoromethoxy)phenyl)-2-chloroethyl)malononitrile (compound 31).

10 Yield: 61%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.43-2.60 (2H, m), 3.43 (1H, dd), 4.03 (1H, dd), 4.22 (1H, dd), 5.33-5.53 (2H, m), 5.78-6.01 (1H, m), 7.35 (2H, m), 7.41 (2H, m).

Production Example 32

15 Using 0.50 g of (1-(4-(trifluoromethoxy)phenyl)-2-propenyl)malononitrile, 4 ml of N,N-dimethylformamide, 83 mg of sodium hydride (60% in oil), and 0.51 g of 4-bromo-1-butene, and according to the process described in Production Example 1, there was obtained 0.56 g of 2-(3-butenyl)-2-(1-(4-(trifluoromethoxy)phenyl)-2-propenyl)malononitrile (compound 32).

20 Yield: 93%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.77-2.08 (2H, m), 2.41-2.51 (2H, m), 3.67 (1H, d), 5.07-5.18 (2H, m), 5.37-5.51 (2H, m), 5.69-5.82 (1H, m), 5.19-5.33 (1H, m), 7.26 (2H, m), 7.45 (2H, m).

Production Example 33

25 Using 0.25 g of (1-(4-(trifluoromethoxy)phenyl)-2-propenyl)malononitrile, 2 ml of N,N-dimethylformamide, 42 mg of sodium hydride (60% in oil), and 0.45 g of allyl bromide, and according to the process described in Production Example 1, there was obtained 0.25 g of 2-allyl-2-(1-(4-(trifluoro-

methoxy)phenyl)-2-propenyl)malononitrile (compound 33).

Yield: 87%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.50-2.73 (2H, m), 3.68 (1H, d),
5.34-5.52 (4H, m), 5.83-5.97 (1H, m), 6.18-6.33 (1H, m), 7.27 (2H, m), 7.46
5 (2H, m).

Production Example 34

Using 0.62 g of (1-(4-(trifluoromethoxy)phenyl)-2-propenyl)malono-
nitrile, 5 ml of N,N-dimethylformamide, 103 mg of sodium hydride (60% in
oil), and 0.56 g of 3-bromo-1-propyne, and according to the process described
10 in Production Example 1, there was obtained 0.59 g of 2-(2-propynyl)-2-(1-
(4-(trifluoromethoxy)phenyl)-2-propenyl)malononitrile (compound 34).

Yield: 83%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.47 (1H, t), 2.74-2.93 (2H, m), 3.96
(1H, d), 5.47-5.55 (2H, m), 6.19-6.31 (1H, m), 7.28 (2H, m), 7.49 (2H, m).

15 Production Example 35

First, 0.41 g of 2-(3-butenyl)-2-(4-hydroxybenzyl)malononitrile and
0.76 g of dibromodifluoromethane was dissolved in 5 ml of N,N-dimethyl-
formamide, and while stirring under ice-cooling, 80 mg of sodium hydride
(60% in oil) was added, and the mixture was heated to 80 °C, followed by
20 stirred for 5 hours. Then, a saturated ammonium chloride aqueous solution
was added to the reaction mixture, which was extracted diethyl ether. The
organic layer was successively washed with water, a saturated sodium
chloride aqueous solution, dried over anhydrous magnesium sulfate, and
then concentrated under reduced pressure. The residue was subjected to
25 silica gel column chromatography to give 0.16 g of 2-(3-butenyl)-2-(4-
(bromodifluoromethoxy)benzyl)malononitrile (compound 35) as a low-polar
compound.

Yield: 25%;

m.p.: 50.2°C.

Also given was 58mg of 2-(3-butenyl)-2-(4-(difluoromethoxy)benzyl)-malononitrile (compound 36) as a high-polar compound.

Yield: 12%;

5 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.02-2.07(2H, m), 2.44-2.52(2H, m), 3.21(2H, s), 5.11-5.20(2H, m), 5.77-5.86(1H, m), 6.54(1H, t), 7.16(2H, d), 7.38(2H, m).

Production Example 36

Using 0.43 g of (3,4-(methylenedioxy)benzyl)malononitrile, 5 ml of
10 N,N-dimethylformamide, 100 mg of sodium hydride (60% in oil), and 0.36 g of 4-bromo-1-butene, and according to the process described in Production Example 1, there was obtained 0.42 g of 2-(3-butenyl)-2-(3,4-(methylenedioxy)benzyl)malononitrile (compound 37).

Yield: 76%;

15 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.99-2.05 (2H, m), 2.45-2.48 (2H, m), 3.14 (2H, s), 5.09-5.20 (2H, m), 5.72-5.90 (1H, m), 6.00 (2H, s), 6.82-6.85 (3H, m).

Production Example 37

First, 0.30 g of 2-(3-butenyl)-2-(4-hydroxybenzyl)malononitrile and
20 0.19 g of allyl bromide was dissolved in 5 ml of N,N-dimethylformamide, and 0.22 g of potassium carbonate was added, followed by stirred overnight at room temperature. Then, water was added to the reaction mixture, which was extracted diethyl ether. The organic layer was successively washed with water, a saturated sodium chloride aqueous solution, dried over anhy-
25 drous magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 0.34 g of 2-(3-butenyl)-2-(4-(2-propenyloxy)benzyl)malononitrile (compound 38).

Yield: 96%;

m.p.: 77.7°C.

Production Example 38

First, 0.48 g of 4-(trifluoromethoxy)benzylidenemalononitrile, 0.10 g of tetrakis(triphenylphosphine)palladium, and 0.26 g of allylmethyl carbonate were dissolved in 20 ml of tetrahydrofuran, and the solution was stirred at room temperature for 10 hours. Then, the residue obtained by concentration under reduced pressure was subjected to silica gel chromatography to give 0.56 g of 2-allyl-2-(4-(trifluoromethoxy)- α -methoxybenzyl)malononitrile (compound 39).

10 Yield: 89%;

$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.66-2.79 (2H, m), 3.36 (3H, s), 4.43 (1H, s), 5.38-5.46 (2H, m), 5.85-5.99 (1H, m), 7.32 (2H, d), 7.53 (2H, d).

Production Example 39

Using 0.50 g of (4-(trifluoromethylthio)benzyl)malononitrile, 6 ml of N,N-dimethylformamide, 90 mg of sodium hydride (60% in oil), and 0.29 g of allyl bromide, and according to the process described in Production Example 1, there was obtained 0.49 g of 2-allyl-2-(4-(trifluoromethylthio)benzyl)malononitrile (compound 41).

Yield: 84%;

20 $^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.69-2.75 (2H, m), 3.21 (2H, s), 5.39-5.51 (2H, m), 5.88-6.02 (1H, m), 7.45 (2H, d), 7.70 (2H, d).

Production Example 40

Using 0.50 g of (4-(trifluoromethylthio)benzyl)malononitrile, 6 ml of N,N-dimethylformamide, 90 mg of sodium hydride (60% in oil), and 0.32 g of 4-bromo-1-butene, and according to the process described in Production Example 1, there was obtained 0.26 g of 2-(3-butenyl)-2-(4-(trifluoromethylthio)benzyl)malononitrile (compound 42).

Yield: 44%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.04-2.10 (2H, m), 2.45-2.54 (2H, m), 3.25 (2H, s), 5.10-5.22 (2H, m), 5.74-5.87 (1H, m), 7.45 (2H, d), 7.71 (2H, m).

Production Example 41

Using 0.51 g of 4-(trifluoromethylthio)benzylidenemalononitrile, 0.10 g of tetrakis(triphenylphosphine)palladium, 0.26 g of allylmethyl carbonate, and 20 ml of tetrahydrofuran, and according to the process described in Production Example 38, there was obtained 0.49 g of 2-allyl-2-(4-(trifluoromethylthio)-α-methoxybenzyl)malononitrile (compound 43).

Yield: 75%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.72-2.76 (2H, m), 3.38 (3H, s), 4.46 (1H, s), 5.38-5.48 (2H, m), 5.79-5.94 (1H, m), 7.56 (2H, m), 7.76 (2H, m).

Production Example 42

Using 1.76 g of (4-ethoxybenzyl)malononitrile, 30 ml of N,N-dimethylformamide, 0.40 g of sodium hydride (60% in oil), and 4.2 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 1.30 g of 2-allyl-2-(4-ethoxybenzyl)malononitrile (compound 44).

Yield: 54%;

m.p.: 84.3°C.

Production Example 43

Using 0.50 g of (4-(trifluoromethoxy)benzyl)malononitrile, 6 ml of N,N-dimethylformamide, 95 mg of sodium hydride (60% in oil), and 0.47 g of isopentyl bromide, and according to the process described in Production Example 1, there was obtained 0.42 g of 2-(3-methylbutyl)-2-(4-(trifluoromethoxy)benzyl)malononitrile (compound 45).

Yield: 65%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 0.96 (3H, d), 1.59-1.65 (3H, m), 1.94-2.01 (2H, m), 3.20 (2H, s), 7.26 (2H, d), 7.43 (2H, d).

Production Example 44

Using 0.50 g of (4-(trifluoromethylthio)benzyl)malononitrile, 6 ml of N,N-dimethylformamide, 90 mg of sodium hydride (60% in oil), and 0.21 g of 1-chloro-2-butene, and according to the process described in Production Example 1, there was obtained 0.40 g of 2-(2-butenyl)-2-(4-(trifluoromethylthio)benzyl)malononitrile (compound 46).

Yield: 66%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.72 (3H, dd, Z), 1.80 (3H, dd, E), 2.68 (2H, d, E), 2.73 (2H, d, Z), 3.18 (2H, s, Z), 3.19 (2H, s, E), 5.49-5.68 (1H, m, E, Z), 5.78-6.00 (1H, m, E, Z), 7.45 (2H, d, E, Z), 7.70 (2H, d, E, Z).

Production Example 45

Using 0.50 g of (4-(trifluoromethylthio)benzyl)malononitrile, 6 ml of N,N-dimethylformamide, 90 mg of sodium hydride (60% in oil), and 0.21 g of 3-chloro-1-butene, and according to the process described in Production Example 1, there was obtained 0.14 g of 2-(1-methyl-2-propenyl)-2-(4-(trifluoromethylthio)benzyl)malononitrile (compound 47).

Yield: 24%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.47 (3H, d), 2.62-2.74 (1H, m), 3.19 (2H, dd), 5.35-5.46 (2H, m), 5.80-5.95 (2H, m), 7.45 (2H, d), 7.69 (2H, d).

20 Production Example 46

Using 1.93 g of (1-(3-chlorophenyl)-1-methylethyl)malononitrile, 30 ml of N,N-dimethylformamide, 0.39 g of sodium hydride (60% in oil), and 3.70 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 1.14 g of 2-allyl-2-(1-(3-chlorophenyl)-1-methylethyl)malononitrile (compound 48).

Yield: 50%;

m.p.: 84.3°C.

Production Example 47

Using 0.60 g of (1-(2-chlorophenyl)-1-methylethyl)malononitrile, 10 ml of N,N-dimethylformamide, 0.12 g of sodium hydride (60% in oil), and 1.2 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 0.60 g of 2-allyl-2-(1-(2-chlorophenyl)-1-methylethyl)malononitrile (compound 49).

Yield: 71%;

$n_D^{23.5}$: 1.5398.

Production Example 48

Using 2.01 g of (4-nitrobenzyl)malononitrile, 50 ml of N,N-dimethylformamide, 0.44 g of sodium hydride (60% in oil), and 4.23 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 1.13 g of 2-allyl-2-(4-nitrobenzyl)malononitrile (compound 50).

Yield: 47%;

m.p.: 94.2°C.

Production Example 49

Using 0.50 g of (4-chlorobenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.12 g of sodium hydride (60% in oil), and 0.27 ml of isopropyl iodide, and according to the process described in the Production Example 1, there was obtained 0.19 g of 2-(4-chlorobenzyl)-2-isopropylmalononitrile (compound 51).

Yield: 31%;

$n_D^{22.5}$: 1.5229.

Production Example 50

Using 0.50 g of (4-(trifluoromethyl)benzyl)malononitrile, 21 ml of N,N-dimethylformamide, 100 mg of sodium hydride (60% in oil), and 0.45 g of 4-bromo-1-butene, and according to the process described in Production Example 1, there was obtained 0.25 g of 2-(3-butenyl)-2-(4-(trifluoromethyl)-

benzyl)malononitrile (compound 52).

Yield: 20%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.05-2.10 (2H, m), 2.46-2.52 (2H, m), 3.28 (2H, s), 5.12-5.22 (2H, m), 5.77-5.86 (1H, m), 7.52 (2H, d), 7.69 (2H, d).

5 Production Example 51

Using 2.25 g of (2,3-dichlorobenzyl)malononitrile, 20 ml of N,N-dimethylformamide, 0.48 g of sodium hydride (60% in oil), and 1.30 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 1.72 g of 2-allyl-2-(2,3-dichlorobenzyl)-
10 malononitrile (compound 53).

Yield: 65%;

$n_D^{23.5}$: 1.5448.

Production Example 52

Using 2.25 g of (2,6-dichlorobenzyl)malononitrile, 20 ml of N,N-dimethylformamide, 0.48 g of sodium hydride (60% in oil), and 1.30 ml of allyl
15 bromide, and according to the process described in the Production Example 1, there was obtained 2.00 g of 2-allyl-2-(2,6-dichlorobenzyl)malononitrile (compound 54).

Yield: 75%;

20 $n_D^{23.5}$: 1.5483.

Production Example 53

First, 0.50 g of 4-(trifluoromethylthio)benzylidenemalononitrile, 60 mg of tris(dibenzylideneacetone)dipalladium-chloroform complex, and 0.11 g of 1,1'-bis(diphenylphosphino)ferrocene were added to 10 ml of tetrahydro-
25 furan, and 0.30 g of allyl chloride and 0.39 g of trimethylsilyl cyanide were further added under an atmosphere of nitrogen, followed by stirring at 75°C for a day. The reaction mixture was then filtered through silica gel and the filtrate was concentrated. The residue was subjected to silica gel chroma-

tography to give 0.42 g of 2-allyl-2-(4-(trifluoromethylthio)- α -cyanobenzyl)-malononitrile (compound 56).

Yield: 67%;

$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.92-3.12 (2H, m), 4.29 (1H, s), 5.59-
5 5.65 (2H, m), 5.81-5.98 (1H, m), 7.63 (2H, d), 7.82 (2H, d).

Production Example 54

Using 0.47 g of 4-(trifluoromethoxy)benzylidenemalononitrile, 60 mg of tris(dibenzylideneacetone)dipalladium-chloroform complex, 0.11 g of 1,1'-bis(diphenylphosphino)ferrocene, 10 ml of tetrahydrofuran, 0.30 g of allyl
10 chloride, and 0.39 g of trimethylsilyl cyanide, and according to the process described in Production Example 53, there was obtained 0.42 g of 2-allyl-2-(4-(trifluoromethoxy)- α -cyanobenzyl)malononitrile (compound 55).

Yield: 70%;

$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.92-3.10 (2H, m), 4.27 (1H, s), 5.58-
15 5.63 (2H, m), 5.91-5.97 (1H, m), 7.37 (2H, d), 7.62 (2H, d).

Production Example 55

Using 0.30 g of allylmalononitrile, 4 ml of N,N-dimethylformamide, 130 mg of sodium hydride (60% in oil), and 0.99 g of 2,4-bis(trifluoromethyl)-benzyl bromide, and according to the process described in Production Exam-
20 ple 1, there was obtained 0.70 g of 2-allyl-2-(2,4-bis(trifluoromethyl)benzyl)-malononitrile (compound 57).

Yield: 72%;

$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.82 (2H, d), 3.47 (2H, s), 5.45-5.58
(2H, m), 5.89-6.05 (1H, m), 7.92 (1H, d), 7.98 (1H, d), 8.02 (1H, s).

25 Production Example 56

Using 0.30 g of allylmalononitrile, 4 ml of N,N-dimethylformamide, 125 mg of sodium hydride (60% in oil), and 0.85 g of 2-chloro-4-(trifluoromethyl)benzyl bromide, and according to the process described in Production

Example 1, there was obtained 0.40 g of 2-allyl-2-(2-chloro-4-(trifluoromethyl)benzyl)malononitrile (compound 58).

Yield: 47%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.84 (2H, d), 3.51 (2H, s), 5.41-5.56
5 (2H, m), 5.88-6.07 (1H, m), 7.62 (1H, d), 7.71 (1H, d), 7.83 (1H, s).

Production Example 57

Using 0.50 g of (4-(trifluoromethoxy)benzyl)malononitrile, 3 ml of N,N-dimethylformamide, 93 mg of sodium hydride (60% in oil), and 0.42 g of 1-bromo-2-butyne, and according to the process described in Production Ex-
10 ample 1, there was obtained 0.47 g of 2-(2-butyne)-2-(4-(trifluoromethoxy)-benzyl)malononitrile (compound 59).

Yield: 70%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.93 (3H, t), 2.85 (2H, q), 3.33 (2H, s),
7.25 (2H, d), 7.45 (2H, d).

15 Production Example 58

Using 0.30 g of (3-butenyl)malononitrile, 5 ml of N,N-dimethylformamide, 110 mg of sodium hydride (60% in oil), and 0.75 g of 2-chloro-4-(trifluoromethyl)benzyl bromide, and according to the process described in Production Example 1, there was obtained 0.30 g of 2-(3-butenyl)-2-(2-chloro-4-(trifluoromethyl)benzyl)malononitrile (compound 60).
20

Yield: 39%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.10-2.17 (2H, m), 2.49-2.52 (2H, m),
3.53 (2H, s), 5.11-5.22 (2H, m), 5.72-5.88 (1H, m), 7.62 (1H, d), 7.70 (1H, d),
7.75 (1H, s).

25 Production Example 59

Using 0.60 g of allylmalononitrile, 8 ml of N,N-dimethylformamide, 255 mg of sodium hydride (60% in oil), and 1.55 g of 4-(methylsulfonyl)benzyl bromide, and according to the process described in Production Example 1,

there was obtained 0.64 g of 2-allyl-2-(4-(methylsulfonyl)benzyl)malononitrile (compound 61).

Yield: 41%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.78 (2H, d), 3.10 (3H, s), 3.29 (2H, s), 5.45-5.53 (2H, m), 5.88-6.07 (1H, m), 7.61 (2H, d), 8.01 (2H, d).

Production Example 60

Using 1.23 g of (2,3,4,5,6-pentafluorobenzyl)malononitrile, 20 ml of N,N-dimethylformamide, 0.24 g of sodium hydride (60% in oil), and 0.63 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 0.98 g of 2-allyl-2-(2,3,4,5,6-pentafluorobenzyl)malononitrile (compound 62).

Yield: 68%;

m.p.: 78.2°C.

Production Example 61

Using 0.15 g of allylmalononitrile, 5 ml of N,N-dimethylformamide, 62 mg of sodium hydride (60% in oil), and 0.43 g of 2-nitro-4-(trifluoromethyl)benzyl bromide, and according to the process described in Production Example 1, there was obtained 0.32 g of 2-allyl-2-(2-nitro-4-(trifluoromethyl)benzyl)malononitrile (compound 63).

Yield: 70%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.88 (2H, d), 3.80 (2H, s), 5.46-5.57 (2H, m), 5.88-6.05 (1H, m), 7.82 (1H, d), 7.94 (1H, d), 8.46 (1H, s).

Production Example 62

Using 0.15 g of allylmalononitrile, 5 ml of N,N-dimethylformamide, 62 mg of sodium hydride (60% in oil), and 0.44 g of 2,6-dichloro-4-(trifluoromethyl)benzyl bromide, and according to the process described in Production Example 1, there was obtained 0.20 g of 2-allyl-2-(2,6-dichloro-4-(trifluoromethyl)benzyl)malononitrile (compound 64).

Yield: 43%;

$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.94 (2H, d), 3.75 (1H, s), 5.50-5.58 (2H, m), 5.95-6.10 (1H, s), 7.71 (2H, s).

Production Example 63

5 Using 0.15 g of (3-butenyl)malononitrile, 5 ml of N,N-dimethylformamide, 55 mg of sodium hydride (60% in oil), and 0.39 g of 2,6-dichloro-4-(trifluoromethyl)benzyl bromide, and according to the process described in Production Example 1, there was obtained 95 mg of 2-(3-butenyl)-2-(2,6-dichloro-4-(trifluoromethyl)benzyl)malononitrile (compound 65).

10 Yield: 22%;

$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.22-2.28 (2H, m), 2.49-2.57 (2H, m), 3.77 (2H, s), 5.13-5.23 (2H, m), 5.78-5.90 (1H, m), 7.69 (2H, s).

Production Example 64

15 Using 0.41 g of (1-(3-chlorophenyl)-2-methylpropyl)malononitrile, 5 ml of N,N-dimethylformamide, 85 mg of sodium hydride (60% in oil), and 0.22 ml of allyl bromide, and according to the process described in the Production Example 1, there was obtained 0.35 g of 2-allyl-2-(1-(3-chlorophenyl)-2-methylpropyl)malononitrile (compound 66).

Yield: 73%;

20 $n_D^{23.0}$: 1.5267.

Production Example 65

25 Using 97 mg of (3-butenyl)malononitrile, 5 ml of N,N-dimethylformamide, 37 mg of sodium hydride (60% in oil), and 0.25 g of 2-nitro-4-(trifluoromethyl)benzyl bromide, and according to the process described in Production Example 1, there was obtained 0.12 g of 2-(3-butenyl)-2-(2-nitro-4-(trifluoromethyl)benzyl)malononitrile (compound 67).

Yield: 43%;

$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.21-2.29 (2H, m), 2.54-2.65 (2H, m),

5.64-5.76 (2H, m), 5.82-5.98 (1H, m), 7.33 (1H, d), 8.03 (1H, m), 8.45 (1H, s).

Production Example 66

Using 0.50 g of (4-chlorobenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.16 g of sodium hydride (60% in oil), and 0.33 ml of methyl iodide, and according to the process described in the Production Example 1, there was obtained 0.23 g of 2-(4-chlorobenzyl)-2-methylmalononitrile (compound 68).

Yield: 43%;

m.p.: 91.1°C.

10 Production Example 67

Using 0.30 g of allylmalononitrile, 4 ml of N,N-dimethylformamide, 124 mg of sodium hydride (60% in oil), and 0.80 g of 3-fluoro-4-(trifluoromethyl)benzyl bromide, and according to the process described in Production Example 1, there was obtained 0.37 g of 2-allyl-2-(3-fluoro-4-(trifluoromethyl)benzyl)malononitrile (compound 69).

Yield: 46%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.77 (2H, d), 3.23 (2H, s), 5.43-5.54 (2H, m), 5.86-5.98 (1H, m), 7.25 (1H, m), 7.29 (1H, d), 7.65-7.72 (1H, m).

Production Example 68

20 Using 0.30 g of allylmalononitrile, 6 ml of N,N-dimethylformamide, 124 mg of sodium hydride (60% in oil), and 0.68 g of 4-(methylthio)benzyl bromide, and according to the process described in Production Example 1, there was obtained 0.42 g of 2-allyl-2-(4-(methylthio)benzyl)malononitrile (compound 70).

25 Yield: 62%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.49 (3H, s), 2.70 (2H, s), 3.16 (2H, s), 5.38-5.47 (2H, m), 5.80-5.99 (1H, m), 7.27 (2H, d), 7.28 (2H, d).

Production Example 69

Using 0.50 g of (4-(trifluoromethyl)benzyl)malononitrile, 6 ml of N,N-dimethylformamide, 98 mg of sodium hydride (60% in oil), and 0.41 g of 1-iodopropane, and according to the process described in Production Example 1, there was obtained 0.21 g of 2-propyl-2-(4-(trifluoromethyl)benzyl)-malononitrile (compound 71).

Yield: 41%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.06 (3H, t), 1.68-1.77 (2H, m), 1.88-1.96 (2H, m), 7.48 (2H, d), 7.63 (2H, m).

Production Example 70

Using 0.50 g of (4-chlorobenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.16 g of sodium hydride (60% in oil), and 0.39 ml of ethyl bromide, and according to the process described in the Production Example 1, there was obtained 0.20 g of 2-(4-chlorobenzyl)-2-ethylmalononitrile (compound 72).

Yield: 35%;

m.p.: 70.9°C.

Production Example 71

Using 0.50 g of (4-chlorobenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.16 g of sodium hydride (60% in oil), and 0.85 g of (Z)-1-bromo-3-hexene, and according to the process described in the Production Example 1, there was obtained 0.22 g of 2-(4-chlorobenzyl)-2-((Z)-3-hexenyl)malononitrile (compound 73).

Yield: 31%;

m.p.: 44.8°C.

Production Example 72

Using 0.56 g of (1-(4-chlorophenyl)ethyl)malononitrile, 5 ml of N,N-dimethylformamide, 160 mg of sodium hydride (60% in oil), and 0.46 ml of allyl bromide, and according to the process described in the Production

Example 1, there was obtained 0.29 g of 2-allyl-2-(1-(4-chlorophenyl)ethyl)-malononitrile (compound 74).

Yield: 43%;

$n_D^{25.5}$: 1.5294.

5 Production Example 73

Using 0.50 g of (4-(trifluoromethyl)benzyl)malononitrile, 6 ml of N,N-dimethylformamide, 98 mg of sodium hydride (60% in oil), and 0.27 g of bromoethane, and according to the process described in Production Example 1, there was obtained 0.33 g of 2-ethyl-2-(4-(trifluoromethyl)benzyl)malono-

10 nitrile (compound 75).

Yield: 58%;

$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 1.35 (2H, t), 2.06 (2H, q), 3.26 (2H, s), 7.52 (2H, d), 7.68 (2H, d).

Production Example 74

15 Using 0.56 g of (1-(4-chlorophenyl)ethyl)malononitrile, 5 ml of N,N-dimethylformamide, 160 mg of sodium hydride (60% in oil), and 0.65 ml of 1-bromo-4-pentene, and according to the process described in the Production Example 1, there was obtained 0.25 g of 2-(1-(4-chlorophenyl)ethyl)-2-(4-pentenyl)malononitrile (compound 76).

20 Yield: 33%;

$n_D^{25.5}$: 1.5204.

Production Example 75

Using 0.50 g of (4-methylbenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.18 g of sodium hydride (60% in oil), and 0.50 ml of allyl

25 bromide, and according to the process described in the Production Example 1, there was obtained 0.37 g of 2-allyl-2-(4-methylbenzyl)malononitrile (compound 77).

Yield: 60%;

m.p.: 74.5°C.

Production Example 76

First, 0.40 g of 2-(3-butenyl)-2-(4-hydroxybenzyl)malononitrile and 0.22 g of acetic anhydride was dissolved in 5 ml of toluene, to which 0.23 g of triethylamine was added, followed by stirring overnight at room temperature. Then, water was added to the reaction mixture, which was extracted with diethyl ether. The organic layer was successively washed with a saturated ammonium chloride aqueous solution, a saturated sodium bicarbonate aqueous solution, a saturated sodium chloride aqueous solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 0.45 g of 2-(3-butenyl)-2-(4-(acetyloxy)benzyl)malononitrile (compound 78).

Yield: 95%;

m.p.: 80.2°C.

Production Example 77

Using 0.50 g of (4-(trifluoromethyl)benzyl)malononitrile, 10 ml of N,N-dimethylformamide, 89 mg of sodium hydride (60% in oil), and 0.33 g of 5-bromo-1-pentene, and according to the process described in Production Example 1, there was obtained 0.16 g of 2-(4-pentenyl)-2-(4-(trifluoromethyl)benzyl)malononitrile (compound 79).

Yield: 25%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.84-1.87 (2H, m), 1.96-2.02 (2H, m), 2.18 (2H, t), 3.25 (2H, s), 5.05-5.11 (2H, m), 5.76-5.86 (1H, m), 7.51 (2H, d), 7.58 (2H, d).

Production Example 78

First, 0.40 g of 2-(3-butenyl)-2-(4-hydroxybenzyl)malononitrile was dissolved in 5 ml of N,N-dimethylformamide, to which 75 mg of sodium

hydride (60% in oil) was added, while stirring under ice cooling. After the evolution of hydrogen gas ceased, while stirring under ice cooling, 0.49 g of 1,1,2,2-tetrafluoro-1-iodoethane was added dropwise, followed by further stirring at room temperature overnight. Then, a saturated ammonium
5 chloride aqueous solution was added to the reaction mixture, which was extracted with diethyl ether. The organic layer was successively washed with water, a saturated aqueous sodium chloride solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 82 mg of
10 2-(3-butenyl)-2-(4-(1,1,2,2-tetrafluoroethoxy)benzyl)malononitrile (compound 80).

Yield: 14%;

m.p.: 60.5°C.

Production Example 79

15 Using 0.40 g of 2-(3-butenyl)-2-(4-hydroxybenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 75 mg of sodium hydride (60% in oil), and 0.45 g of 2,2,2-trifluoro-1-iodoethane, and according to the process described in the Production Example 78, there was obtained 70 mg of 2-(3-butenyl)-2-(4-(2,2,2-trifluoroethoxy)benzyl)malononitrile (compound 81).

20 Yield: 13%;

m.p.: 58.0°C.

Production Example 80

First, 0.48 g of (4-(trifluoromethoxy)benzyliden)malononitrile and 1.0 g of ethanol was dissolved in 20 ml of tetrahydrofuran, to which 0.10 g of
25 tetrakis(triphenylphosphine)palladium and 0.26 g of allyl methyl carbonate was added, followed by further stirring for 10 hours at room temperature. Then, the reaction mixture was concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 0.65 g of

2-allyl-2-(4-(trifluoromethoxy)- α -ethoxybenzyl)malononitrile (compound 82).

Yield: 99%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.26(3H, t), 2.66-2.79(2H, m), 3.36-3.57(2H, m), 4.54(1H, s), 5.38-5.46(2H, m), 5.87-5.99(1H, m), 7.30(2H, d),
5 7.55(2H, d).

Production Example 81

Using 0.36 g of (4-cyanobenzyliden)malononitrile, 0.10 g of tetra-
kis(triphenylphosphine)palladium, and 0.26 g of allyl methyl carbonate, and
20 ml of tetrahydrofuran, and according to the process described in the
10 Production Example 38, there was obtained 0.11 g of 2-allyl-2-(4-cyano- α -
methoxybenzyl)malononitrile (compound 83).

Yield: 22%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.72-2.81(2H, m), 3.38(3H, s),
4.47(1H, s), 5.39-5.49(2H, m), 5.80-5.98(1H, m), 7.64(2H, d), 7.79(2H, d).

15 Production Example 82

Using 0.38 g of (4-chlorobenzyliden)malononitrile, 0.10 g of tetra-
kis(triphenylphosphine)palladium, and 0.26 g of allyl methyl carbonate, and
20 ml of tetrahydrofuran, and according to the process described in the
Production Example 38, there was obtained 0.44 g of 2-allyl-2-(4-chloro- α -
20 methoxybenzyl)malononitrile (compound 84).

Yield: 84%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.65-2.76(2H, m), 3.35(3H, s),
4.41(1H, s), 5.37-5.47(2H, m), 5.85-6.00(1H, m), 7.45(4H, bs).

Production Example 83

25 Using 0.41 g of (2,2-dimethylpropyl)malononitrile, 7 ml of N,N-di-
methylformamide, 0.13 g of sodium hydride (60% in oil), and 0.92 g of 4-
(trifluoromethyl)benzyl bromide, and according to the process described in
the Production Example 1, there was obtained 0.59 g of 2-(2,2-dimethyl-

propyl)-2-(4-(trifluoromethoxy)benzyl)malononitrile (compound 85).

Yield: 63%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.20(9H, s), 1.94(2H, s), 3.21(2H, s), 7.26(2H, d), 7.44(2H, d).

5 Production Example 84

Using 1.36 g of (2,2-dimethylpropyl)malononitrile, 20 ml of N,N-dimethylformamide, 0.43 g of sodium hydride (60% in oil), and 3.00 g of 4-bromobenzyl bromide, and according to the process described in the Production Example 1, there was obtained 2.74 g of 2-(4-bromobenzyl)-2-(2,2-dimethylpropyl)malononitrile (compound 86).

Yield: 90%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.19(9H, s), 1.91(2H, s), 3.16(2H, s), 7.28(2H, d), 7.54(2H, d).

 Production Example 85

15 Using 0.50 g of (4-(trifluoromethoxy)benzyl)malononitrile, 8 ml of N,N-dimethylformamide, 96 mg of sodium hydride (60% in oil), and 0.57 g of isobutyl bromide, and according to the process described in the Production Example 1, there was obtained 0.31 g of 2-isobutyl-2-(4-(trifluoromethoxy)benzyl)malononitrile (compound 87).

20 Yield: 51%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.13(6H, d), 1.88(2H, d), 2.13(1H, hept), 3.20(2H, s), 7.26(2H, d), 7.43(2H, d).

 Production Example 86

25 Using 0.50 g of (4-(trifluoromethoxy)benzyl)malononitrile, 8 ml of N,N-dimethylformamide, 96 mg of sodium hydride (60% in oil), and 0.63 g of pentyl bromide, and according to the process described in the Production Example 1, there was obtained 0.45 g of 2-pentyl-2-(4-(trifluoromethoxy)benzyl)malononitrile (compound 88).

Yield: 70%;

$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 0.93(3H, t), 1.29-1.49(4H, m), 1.62-1.80(2H, m), 1.92-1.99(2H, m), 3.20(2H, s), 7.26(2H, d), 7.41(2H, d).

Production Example 87

5 Using 0.50 g of (3-(trifluoromethoxy)benzyl)malononitrile, 20 ml of N,N-dimethylformamide, 92 mg of sodium hydride (60% in oil), and 0.38 g of allyl bromide, and according to the process described in the Production Example 1, there was obtained 0.54 g of 2-allyl-2-(3-(trifluoromethoxy)-benzyl)malononitrile (compound 89).

10 Yield: 93%;

$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.70-2.75(2H, m), 3.21(2H, s), 5.30-5.51(2H, m), 5.86-6.02(1H, m), 7.25-7.50(4H, m).

Production Example 88

15 Using 0.50 g of (3-(trifluoromethoxy)benzyl)malononitrile, 20 ml of N,N-dimethylformamide, 92 mg of sodium hydride (60% in oil), and 420 mg of 4-bromo-1-butene, and according to the process described in the Production Example 1, there was obtained 0.28 g of 2-(3-butenyl)-2-(3-(trifluoromethoxy)benzyl)malononitrile (compound 90).

Yield: 46%;

20 $^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.00-2.09(2H, m), 2.41-2.53(2H, m), 3.24(2H, s), 5.07-5.21(2H, m), 5.73-5.89(1H, m), 7.25-7.50(4H, m).

Production Example 89

25 First, 1.0 g of (4-methoxybenzylidene)malononitrile was dissolved in 30 ml of tetrahydrofuran, to which 0.57 g of trimethylsilyl cyanide was added at room temperature under a atmosphere of nitrogen, followed by stirred for 30 minutes. Then, 5.5 ml of tetrabutylammonium fluoride (1.0 M solution of tetrahydrofuran) was added dropwise to the mixture under ice-cooling, followed by stirred for 4 hours keeping ice-cooling. Then, 0.98 g of allyl

bromide was added dropwise followed by stirring overnight at room temperature. Then, a saturated ammonium chloride aqueous solution was added to the reaction mixture, which was extracted diethyl ether. The organic layer was successively washed with water, a saturated sodium
5 chloride aqueous solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 1.0 g of 2-allyl-2-(4-methoxy- α -cyanobenzyl)malononitrile (compound 91).

Yield: 76%;

10 $^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.98(2H, ddd), 3.85(3H, s), 4.26(1H, s), 5.54-5.62(2H, m), 5.87-6.07(1H, m), 7.04(2H, d), 7.47(2H, d).

Production Example 90

Using 1.0 g of (4-methylbenzyliden)malononitrile, 30 ml of tetrahydrofuran, 0.62 g of trimethylsilyl cyanide, 6.0 ml of tetrabutylammonium
15 fluoride (1.0 M solution of tetrahydrofuran), and 1.08 g of allyl bromide, and according to the process described in the Production Example 89, there was obtained 1.0 g of 2-allyl-2-(4-methyl- α -cyanobenzyl)malononitrile (compound 92).

Yield: 76%;

20 $^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.41(3H, s), 2.96(2H, ddd), 4.23(1H, s), 5.54-5.60(2H, m), 5.87-6.01(1H, m), 7.31(2H, d), 7.43(2H, d).

Production Example 91

Using 0.50 g of (4-(methoxycarbonyl)benzylidene)malononitrile, 70 mg of tris(dibenzylideneacetone)dipalladium-chloroform complex, 0.14 g of
25 1,1'-bis(diphenylphosphino)ferrocene, 12 ml of tetrahydrofuran, and 0.37 g of allyl chloride, and according to the process described in the Production Example 53, there was obtained 0.31 g of 2-allyl-2-(4-(methoxycarbonyl)- α -cyanobenzyl)malononitrile (compound 93).

Yield: 48%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.92-3.13(2H, m), 3.96(3H, s), 4.32(1H, s), 5.57-5.65(2H, m), 5.89-6.03(1H, m), 7.65(2H, d), 8.19(2H, d).

Production Example 92

5 Using 0.3 g of (3-butenyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.1 g of sodium hydride (60% in oil), and 0.72 g of 3,5-bis(trifluoromethyl)benzyl bromide, and according to the process described in the Production Example 1, there was obtained 0.12 g of 2-(3,5-bis(trifluoromethyl)-benzyl)-2-(3-butenyl)malononitrile (compound 94).

10 Yield: 14%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.08-2.13(2H, m), 2.48-2.56(2H, m), 3.34(2H, s), 5.14-5.23(2H, m), 5.78-5.87(1H, m), 7.86(2H, s), 7.95(1H, s).

Production Example 93

15 First, 0.72 g of 2,3-dimethoxybenzyl bromide was dissolved in 3 ml of N,N-dimethylformamide, to which a suspension 0.05 g of sodium hydride (60% in oil) and 0.3 g of allylmalononitrile in 2ml of N,N-dimethylformamide was added dropwise, while stirring under ice cooling, followed by further stirring at 0°C for 4 hours. Then, 10% hydrochloric acid was added to the reaction mixture, which was extracted with ethyl acetate. The organic
20 layer was successively washed with water, a saturated aqueous sodium chloride solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 0.34 g of 2-allyl-2-(2,3-dimethoxybenzyl)-malononitrile (compound 95).

25 Yield: 46%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.67(2H, d), 3.31(2H, s), 3.88(3H, s), 3.90(3H, s), 5.37-5.94(2H, m), 5.84-6.01(1H, s), 6.90-7.06(3H, m).

Production Example 94

Using 0.47 g of 4-vinylbenzyl chloride, 5 ml of N,N-dimethylformamide, 0.13 g of sodium hydride (60% in oil), and 0.3 g of allylmalononitrile, and according to the process described in the Production Example 93, there was obtained 0.22 g of 2-allyl-2-(4-vinylbenzyl)malononitrile (compound 96).

5 Yield: 35%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.69(2H, d), 3.19(2H, s), 5.29(1H, dd), 5.44(2H, dd), 5.77(1H, dd), 5.89-6.04(1H, m), 6.72(1H, dd), 7.33(2H, d), 7.44(2H, d).

Production Example 95

10 Using 0.40 g of 4-acetylbenzyl chloride, 5 ml of N,N-dimethylformamide, 0.08 g of sodium hydride (60% in oil), and 0.2 g of allylmalononitrile, and according to the process described in the Production Example 93, there was obtained 0.25 g of 2-(4-acetylbenzyl)-2-allylmalononitrile (compound 97).

Yield: 56%;

15 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.63(3H, s), 2.73(2H, d), 3.22(2H, s), 4.89-5.02(2H, m), 5.87-6.05(1H, m), 7.49(2H, d), 7.97(2H, d).

Production Example 96

20 Using 0.30 g of 2-(3-butenyl)-2-(4-hydroxybenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 60 mg of sodium hydride (60% in oil), and 0.18 g of ethyl bromide, and according to the process described in the Production Example 78, there was obtained 255 mg of 2-(3-butenyl)-2-(4-ethoxybenzyl)malononitrile (compound 98).

Yield: 75%;

25 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.42(3H, t), 1.96-2.04(2H, m), 2.39-2.55(2H, m), 3.17(2H, s), 4.04(2H, q), 5.08-5.19(2H, m), 5.71-5.92(1H, m), 6.90(2H, bd), 7.27(2H, bd).

Production Example 97

Using 0.30 g of 2-(3-butenyl)-2-(4-hydroxybenzyl)malononitrile, 5 ml

of N,N-dimethylformamide, 60 mg of sodium hydride (60% in oil), and 0.28 g of propyl iodide, and according to the process described in the Production Example 78, there was obtained 215 mg of 2-(3-butenyl)-2-(4-propoxybenzyl)malononitrile (compound 99).

5 Yield: 60%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.04(3H, t), 1.72-1.87(2H, m), 1.97-2.04(2H, m), 2.41-2.50(2H, m), 3.17(2H, s), 3.92(2H, t), 5.08-5.20(2H, m), 5.70-5.90(1H, m), 6.90(2H, bd), 7.27(2H, bd).

Production Example 98

10 Using 0.30 g of 2-(3-butenyl)-2-(4-hydroxybenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 60 mg of sodium hydride (60% in oil), and 0.21 g of isopropyl bromide, and according to the process described in the Production Example 78, there was obtained 227 mg of 2-(3-butenyl)-2-(4-isopropoxybenzyl)malononitrile (compound 100).

15 Yield: 64%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.34(6H, d), 1.97-2.04(2H, m), 2.41-2.52(2H, m), 3.16(2H, s), 4.55(1H, hept), 5.08-5.19(2H, m), 5.72-5.89(1H, m), 6.89(2H, d), 7.26(2H, d).

Production Example 99

20 Using 0.72 g of 4-ethylbenzyl chloride, 5 ml of N,N-dimethylformamide, 0.19 g of sodium hydride (60% in oil), and 0.5 g of allylmalononitrile, and according to the process described in the Production Example 93, there was obtained 0.48 g of 2-allyl-2-(4-ethylbenzyl)malononitrile (compound 101).

25 Yield: 57%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.25(3H, t), 2.61-2.74(4H, m), 3.18(2H, s), 5.37-5.49(2H, m), 5.88-6.03(1H, m), 7.21-7.33(4H, m).

Production Example 100

Using 0.79 g of 4-isopropylbenzyl chloride, 5 ml of N,N-dimethylformamide, 0.19 g of sodium hydride (60% in oil), and 0.5 g of allylmalononitrile, and according to the process described in the Production Example 93, there was obtained 0.57 g of 2-allyl-2-(4-isopropylbenzyl)malononitrile (compound 102).

Yield: 62%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.24(6H, d), 2.68(2H, d), 2.91(1H, hept), 3.16(2H, s), 5.38-5.47(2H, m), 5.86-6.00(1H, m), 7.24(2H, d), 7.29(2H, d).

10 Production Example 101

Using 0.72 g of (4-(trifluoromethoxy)benzyliden)malononitrile, 20 ml of benzene, 1.99 g of allyl tributyl tin, 0.20 g of azobis(isobutyronitrile) and 2.76 g of 1,1-dimethylethyl iodide, and according to the process described in the Production Example 30, there was obtained 0.20 g of 2-allyl-2-(1-(4-(trifluoromethoxy)phenyl)-2,2-dimethylpropyl)malononitrile (compound 103).

Yield: 61%;

$n_D^{20.5}$: 1.4762.

Production Example 102

Using 0.23 g of (4-(trifluoromethyl)benzyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.1 g of sodium hydride (60% in oil), and 0.15 g of 1-bromopentane, and according to the process described in the Production Example 1, there was obtained 0.12 g of 2-pentyl-2-(4-(trifluoromethyl)benzyl)malononitrile (compound 104).

Yield: 46%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 0.93(3H, t), 1.34-1.45(4H, m), 1.67-1.79(2H, m), 1.94-2.00(2H, m), 3.25(2H, s), 7.51(2H, d), 7.68(2H, d).

Production Example 103

Using 0.23 g of (4-(trifluoromethyl)benzyl)malononitrile, 5 ml of

N,N-dimethylformamide, 0.1 g of sodium hydride (60% in oil), and 0.15 g of 1-bromo-3-methylbutane, and according to the process described in the Production Example 1, there was obtained 0.14 g of 2-(3-methylbutyl)-2-(4-(trifluoromethyl)benzyl)malononitrile (compound 105).

5 Yield: 54%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 0.96(6H, d), 1.57-1.72(3H, m), 1.96-2.04(2H, m), 3.25(2H, s), 7.52(2H, d), 7.68(2H, d).

Production Example 104

Using 0.23 g of (4-(trifluoromethyl)benzyl)malononitrile, 5 ml of
10 N,N-dimethylformamide, 0.1 g of sodium hydride (60% in oil), and 0.15 g of 1-bromo-3-methyl-2-butene, and according to the process described in the Production Example 1, there was obtained 0.18 g of 2-(3-methyl-2-butenyl)-2-(4-(trifluoromethyl)benzyl)malononitrile (compound 106).

Yield: 68%;

15 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.73(3H, s), 1.85(3H, s), 2.74(2H, d), 3.23(2H, s), 5.34(1H, t), 7.52(2H, d), 7.68(2H, d).

Production Example 105

Using 0.23 g of (4-(trifluoromethyl)benzyl)malononitrile, 5 ml of
20 N,N-dimethylformamide, 0.1 g of sodium hydride (60% in oil), and 0.14 g of 1-bromo-2-butene, and according to the process described in the Production Example 1, there was obtained 0.18 g of 2-(2-butenyl)-2-(4-(trifluoromethyl)benzyl)malononitrile (compound 107).

Yield: 74%;

25 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.74(Z, 3H, dd), 1.81(E, 3H, dd), 2.68(E, 2H, d), 2.80(Z, 2H, d), 3.22(E, 2H, s), 3.25(Z, 2H, s), 5.52-5.64(1H, m), 5.81-5.95(1H, m), 7.52(2H, d), 7.68(2H, d).

Production Example 106

Using 0.23 g of (4-(trifluoromethyl)benzyl)malononitrile, 5 ml of

N,N-dimethylformamide, 0.1 g of sodium hydride (60% in oil), and 0.14 g of 3-bromo-2-methylpropen, and according to the process described in the Production Example 1, there was obtained 0.20 g of 2-(2-methyl-2-propenyl)-2-(4-(trifluoromethyl)benzyl)malononitrile (compound 108).

5 Yield: 71%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.99(3H, s), 2.71(2H, s), 3.27(2H, s), 5.13(1H, d), 5.21(1H, d), 7.54(2H, d), 7.69(2H, d).

Production Example 107

Using 0.23 g of (4-(trifluoromethyl)benzyl)malononitrile, 5 ml of
10 N,N-dimethylformamide, 0.1 g of sodium hydride (60% in oil), and 0.14 g of 1-bromobutane, and according to the process described in the Production Example 1, there was obtained 0.16 g of 2-butyl-2-(4-(trifluoromethyl)benzyl)malononitrile (compound 109).

Yield: 57%;

15 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 0.98(3H, t), 1.45(2H, hex), 1.67-1.77(2H, m), 1.95-2.01(2H, m), 3.25(2H, s), 7.52(2H, d), 7.68(2H, d).

Production Example 108

Using 0.23 g of (4-(trifluoromethyl)benzyl)malononitrile, 5 ml of
N,N-dimethylformamide, 0.1 g of sodium hydride (60% in oil), and 0.14 g of
20 1-bromo-2-methylpropane, and according to the process described in the Production Example 1, there was obtained 0.13 g of 2-(2-methylpropyl)-2-(4-(trifluoromethyl)benzyl)malononitrile (compound 110).

Yield: 46%;

25 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.13(6H, d), 1.89(2H, d), 2.07-2.20(1H, m), 3.25(2H, s), 7.52(2H, d), 7.68(2H, d).

Production Example 109

Using 0.23 g of (4-(trifluoromethyl)benzyl)malononitrile, 5 ml of
N,N-dimethylformamide, 0.1 g of sodium hydride (60% in oil), and 0.15 g of

2-bromobutane, and according to the process described in the Production Example 1, there was obtained 0.07 g of 2-(1-methylpropyl)-2-(4-(trifluoromethyl)benzyl)malononitrile (compound 111).

Yield: 25%;

5 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.07(3H, t), 1.31(3H, d), 1.42-1.52(1H, m), 1.91-2.02(2H, m), 3.23(2H, dd), 7.53(2H, d), 7.68(2H, d).

Production Example 110

Using 0.23 g of (4-(trifluoromethyl)benzyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.1 g of sodium hydride (60% in oil), and 0.15 g of
10 2-bromopentane, and according to the process described in the Production Example 1, there was obtained 0.09 g of 2-(1-methylbutyl)-2-(4-(trifluoromethyl)benzyl)malononitrile (compound 112).

Yield: 30%;

15 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 1.01(3H, t), 1.31(3H, d), 1.31-1.66(3H, m), 1.72-1.84(1H, m), 2.00-2.10(1H, m), 3.22(2H, dd), 7.54(2H, d), 7.68(2H, d).

Production Example 111

Using 0.23 g of (4-(trifluoromethyl)benzyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.1 g of sodium hydride (60% in oil), and 0.17 g of
20 2-bromohexane, and according to the process described in the Production Example 1, there was obtained 0.07 g of 2-(1-methylpentyl)-2-(4-(trifluoromethyl)benzyl)malononitrile (compound 113).

Yield: 21%;

25 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 0.95(3H, t), 1.31(3H, d), 1.30-1.54(5H, m), 1.79-1.91(1H, m), 1.98-2.07(1H, m), 3.22(2H, dd), 7.53(2H, d), 7.68(2H, d).

Production Example 112

Using 0.54 g of 2,3-difluorobenzyl bromide, 5 ml of N,N-dimethyl-

formamide, 0.1 g of sodium hydride (60% in oil), and 0.28 g of allylmalononitrile, and according to the process described in the Production Example 93, there was obtained 0.31 g of 2-allyl-2-(2,3-difluorobenzyl)malononitrile (compound 114).

5 Yield: 52%;

$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.74(2H, d), 3.33(2H, s), 5.41-5.49(2H, m), 5.88-5.99(1H, m), 7.15-7.26(3H, m).

Production Example 113

Using 0.69 g of (4-(2-butyloxy))benzyl bromide, 5 ml of N,N-dimethylformamide, 0.11 g of sodium hydride (60% in oil), and 0.30 g of allylmalononitrile, and according to the process described in the Production Example 93, there was obtained 0.31 g of 2-allyl-2-(4-(2-butyloxy)benzyl)-malononitrile (compound 115).

Yield: 40%;

15 $^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 0.97(3H, t), 1.30(3H, d), 1.56-1.78(2H, m), 2.70(2H, d), 3.16(2H, s), 4.27-4.35(1H, m), 5.39-5.47(2H, m), 5.84-6.01(1H, m), 6.91(2H, d), 7.27(2H, d).

Production Example 114

Using 0.80 g of 4-fluoro-3-phenoxybenzyl bromide, 5 ml of N,N-dimethylformamide, 0.11 g of sodium hydride (60% in oil), and 0.30 g of allylmalononitrile, and according to the process described in the Production Example 93, there was obtained 0.32 g of 2-allyl-2-(4-fluoro-3-phenoxybenzyl)malononitrile (compound 116).

Yield: 37%;

25 $^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.69(2H, d), 3.10(2H, s), 5.37-5.47(2H, m), 5.86-5.97(1H, m), 7.01-7.37(8H, m).

Production Example 115

Using 0.70 g of 4-(*p*-tolylthio)benzyl chloride, 5 ml of N,N-dimethyl-

formamide, 0.11 g of sodium hydride (60% in oil), and 0.30 g of allylmalononitrile, and according to the process described in the Production Example 93, there was obtained 0.38 g of 2-allyl-2-(4-(*p*-tolylthio)benzyl)malononitrile (compound 117).

5 Yield: 37%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.34(3H, s), 2.69(2H, d), 3.15(2H, s), 5.39-5.48(2H, m), 5.86-5.98(1H, m), 7.23-7.25(8H, m).

Production Example 116

Using 0.74 g of 3-phenoxybenzyl bromide, 5 ml of N,N-dimethyl-
10 formamide, 0.11 g of sodium hydride (60% in oil), and 0.30 g of allylmalononitrile, and according to the process described in the Production Example 93, there was obtained 0.54 g of 2-allyl-2-(3-phenoxybenzyl)malononitrile (compound 118).

Yield: 67%;

15 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.70(2H, d), 3.15(2H, s), 5.37-5.47(2H, m), 5.87-5.98(1H, m), 6.91-7.08(6H, m), 7.28-7.37(3H, m).

Production Example 117

Using 0.66 g of 4-(*m*-tolylloxy)benzyl bromide, 5 ml of N,N-dimethyl-
20 formamide, 0.11 g of sodium hydride (60% in oil), and 0.30 g of allylmalononitrile, and according to the process described in the Production Example 93, there was obtained 0.38 g of 2-allyl-2-(4-(*m*-tolylloxy)benzyl)malononitrile (compound 119).

Yield: 45%;

25 ¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.35(3H, s), 2.71(2H, d), 3.17(2H, s), 5.44(2H, dd), 5.86-6.04(1H, m), 6.81-7.01(4H, m), 7.20-7.35(4H, m).

Production Example 118

Using 0.30 g of (2,4,6-trifluorobenzyl)malononitrile, 5 ml of N,N-dimethylformamide, 0.06 g of sodium hydride (60% in oil), and 0.17 g of allyl

bromide, and according to the process described in the Production Example 1, there was obtained 0.21 g of 2-allyl-2-(2,4,6-trifluorobenzyl)malononitrile (compound 120).

Yield: 59%;

5 $^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.75(2H, d), 3.31(2H, s), 5.37-5.46(2H, m), 5.90-6.01(1H, m), 6.81(2H, dd).

Production Example 119

Using 0.84 g of 4-(4-chlorophenoxy)benzyl bromide, 5 ml of N,N-dimethylformamide, 0.11 g of sodium hydride (60% in oil), and 0.30 g of allylmalononitrile, and according to the process described in the Production Example 93, there was obtained 0.50 g of 2-allyl-2-(4-(*p*-chlorophenoxy)benzyl)malononitrile (compound 121).

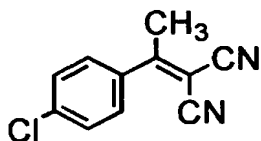
Yield: 55%;

15 $^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.72(2H, d), 3.17(2H, s), 5.41-5.49(2H, m), 5.88-6.00(1H, m), 6.96-7.01(4H, m), 7.25-7.36(4H, m).

The following will describe some production examples for intermediate compounds as reference production examples.

Reference Production Example 1

First, 1.00 g of (4-chloro- α -methylbenzylidene)malononitrile of the
20 formula:



was dissolved in 20 ml of diethyl ether, to which a catalytic amount of copper (I) iodide was added, and while stirring under ice cooling, a solution of methyl magnesium iodide in diethyl ether (prepared from 0.30 g of magnesium, 10 ml of diethyl ether, and 0.86 ml of methyl iodide) was added drop-
25 wise, followed by stirring for 30 minutes under ice cooling. Then, 10%

hydrochloric acid was added to the reaction mixture, which was extracted with ethyl ether. The organic layer was successively washed with 10% hydrochloric acid, a saturated aqueous sodium chloride solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 0.74 g of (1-(4-chlorophenyl)-1-methylethyl)malononitrile (the intermediate (2)).

Yield: 69%.

Reference Production Example 2

First, 1.02 g of (4-chlorobenzylidene)malononitrile was dissolved in 20 ml of tetrahydrofuran, to which a catalytic amount of copper (I) iodide was added, and while stirring under ice cooling, a solution of isopropyl magnesium bromide in tetrahydrofuran (prepared from 0.34 g of magnesium, 10 ml of tetrahydrofuran, and 1.46 ml of isopropyl bromide) was added dropwise, followed by stirring for 30 minutes under ice cooling. Then, 10% hydrochloric acid was added to the reaction mixture, which became acidic and was extracted with ethyl ether. The organic layer was successively washed with 10% hydrochloric acid, a saturated aqueous sodium chloride solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 0.66 g of (1-(4-chlorophenyl)-2-methylpropyl)malononitrile (the intermediate (3)).

Yield: 52%.

Reference Production Example 3

First, 4.44 g of (4-(trifluoromethyl)benzylidene)malononitrile was dissolved in 20 ml of ethanol, and while stirring at room temperature, a suspension of 0.19 g of sodium borohydride in 5 ml of ethanol was added dropwise, followed by stirring at room temperature for 30 minutes. Then, 10%

hydrochloride acid was added to the reaction mixture, which became acidic and was extracted with diethyl ether. The organic layer was successively washed with 10% hydrochloric acid, a saturated aqueous sodium chloride solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 2.30 g of (4-(trifluoromethyl)benzyl)malononitrile (the intermediate (4)).

Yield: 51%.

Reference Production Example 4

First, 3.00 g of (4-chloro- α -methylbenzylidene)malononitrile was dissolved in 20 ml of ethanol, and while stirring at room temperature, a suspension of 0.15 g of sodium borohydride in 5 ml of ethanol was added dropwise, followed by stirring at room temperature for 30 minutes. Then, 10% hydrochloride acid was added to the reaction mixture, which was extracted with diethyl ether. The organic layer was successively washed with 10% hydrochloric acid, a saturated aqueous sodium chloride solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 1.70 g of (1-(4-chlorophenyl)ethyl)malononitrile (the intermediate (6)).

Yield: 56%.

Reference Production Example 5

First, 10.0 g of 4-(trifluoromethoxy)benzaldehyde and 3.50 g of malononitrile were dissolved in 60 ml of 70% (w/w) aqueous ethanol, to which a catalytic amount of benzyltrimethylammonium hydroxide was added, and the mixture was stirred at room temperature overnight. Then, a saturated aqueous sodium chloride solution was added to the reaction mixture, which was extracted with ethyl acetate. The organic layer was washed with a saturated aqueous sodium chloride solution, dried over anhydrous magne-

sium sulfate, and then concentrated under reduced pressure. The residue was recrystallized from t-butyl methyl ether and hexane to give 9.24 g of (4-(trifluoromethoxy)benzylidene)malononitrile.

Yield: 74%;

5 $^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 7.37 (2H, d), 7.76 (1H, s), 7.98 (2H, d).

Then, 2.61 g of (4-(trifluoromethoxy)benzylidene)malononitrile was dissolved in 20 ml of tetrahydrofuran, and while stirring at room temperature, a suspension of 0.11 g of sodium borohydride in 5 ml of ethanol was
10 added dropwise, followed by stirring at room temperature for 30 minutes. Then, 10% hydrochloric acid was added, and the mixture was extracted with diethyl ether. The organic layer was successively washed with 10% hydrochloric acid, a saturated aqueous sodium chloride solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure.
15 The residue was subjected to silica gel column chromatography to give 2.20 g of (4-(trifluoromethoxy)benzyl)malononitrile (the intermediate (7)).

Yield: 83%.

Reference Production Example 6

Using 1.19 g of (4-(trifluoromethoxy)benzylidene)malononitrile, 20
20 ml of tetrahydrofuran, a catalytic amount of copper (I) iodide, and a solution of isopropyl magnesium bromide in tetrahydrofuran (prepared from 0.39 g of magnesium, 10 ml of tetrahydrofuran, and 2.36 g of isopropyl bromide), and according to the process described in Reference Production Example 2, there was obtained 0.77 g of (1-(4-(trifluoromethoxy)phenyl)-2-methylpropyl)malononitrile (the intermediate (8)).
25

Yield: 55%.

Reference Production Example 7

Using 1.19 g of (4-(trifluoromethoxy)benzylidene)malononitrile, 20 ml of

tetrahydrofuran, a catalytic amount of copper (I) iodide, and 12.5 ml of a solution of methyl magnesium bromide in tetrahydrofuran (about 1 M, available from Tokyo Kasei Kogyo Co., Ltd), and according to the process described in Reference Production Example 2, there was obtained 0.76 g of
5 (1-(4-(trifluoromethoxy)phenyl)ethyl)malononitrile (the intermediate (10)).

Yield: 60%.

Reference Production Example 8

First, 4.46 g of (3,4-dichlorobenzylidene)malononitrile was dissolved in 20 ml of tetrahydrofuran, and while stirring at room temperature, a sus-
10 pension of 0.19 g of sodium borohydride in 5 ml of ethanol was added drop-
wise, followed by stirring at room temperature for 30 minutes. Then, 10% hydrochloride acid was added and the mixture was extracted with diethyl ether. The organic layer was successively washed with 10% hydrochloric acid, a saturated aqueous sodium chloride solution, dried over anhydrous
15 magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 3.15 g of (3,4-dichlorobenzyl)malononitrile (the intermediate (12)).

Yield: 70%.

Reference Production Example 9

20 Using 4.46 g of (2,4-dichlorobenzylidene)malononitrile, 20 ml of tetrahydrofuran, and a suspension of 0.19 g of sodium borohydride in 5 ml of ethanol, and according to the process described in Reference Production Example 8, there was obtained 3.10 g of (2,4-dichlorobenzyl)malononitrile (the intermediate (13)).

25 Yield: 69%.

Reference Production Example 10

First, 10.0 g of 4-(trifluoromethylthio)benzaldehyde and 2.92 g of malononitrile were dissolved in 50 ml of 70% (w/w) aqueous ethanol, to

which a catalytic amount of benzyltrimethylammonium hydroxide was added, and the mixture was stirred at room temperature overnight. Then, a saturated aqueous sodium chloride solution was added to the reaction mixture, which was extracted with ethyl acetate. The organic layer was washed with a saturated aqueous sodium chloride solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure. The residue was recrystallized with a solvent system consisting of t-butyl methyl ether and hexane to give 10.5 g of (4-(trifluoromethylthio)benzylidene)malononitrile.

10 Yield: 85%;

¹H-NMR (CDCl₃, TMS, δ (ppm)): 7.78 (1H, s), 7.79 (2H, d), 7.93 (2H, d).

Then, 8.00 g of (4-(trifluoromethylthio)benzylidene)malononitrile and 3.35 g of benzaldehyde were dissolved in 320 ml of ethanol, and while stirring at room temperature, 3.41g of phenylenediamine was slowly added, and the mixture was stirred at room temperature for 5 hours. Then, the reaction mixture was concentrated, 300 ml of t-butyl methyl ether was added, and insoluble matters were filtered. The filtrate was concentrated and the resulting residue was subjected to silica gel chromatography to give 6.22 g of (4-(trifluoromethylthio)benzyl)malononitrile (the intermediate (14)).

20 Yield: 77%.

Reference Production Example 11

First, 9.78 g of malononitrile, 954 mg of tetrabutylammonium bromide, and 10.0 g of 4-bromo-1-butene were mixed, and while stirring at 0°C under an atmosphere of nitrogen, 8.3 g of potassium t-butoxide was slowly added. The mixture was further stirred at room temperature for 12 hours. Then, the reaction mixture was poured into water, followed by extraction with t-butyl methyl ether. The organic layer was washed with

water, a saturated aqueous sodium chloride solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 2.31 g of (3-butenyl)malononitrile (the intermediate (16)).

5 Yield: 26%.

Reference Production Example 12

Using 4.00 g of (4-(trifluoromethoxy)benzylidene)malononitrile, 30 ml of tetrahydrofuran, 175 mg of copper (I) bromide dimethyl sulfide complex, and 26 ml of a solution (0.98 M) of vinyl magnesium bromide in tetrahydro-
10 furan, and according to the process described in Reference Production Example 2, there was obtained 1.60 g of (1-(4-trifluoromethoxyphenyl))-2-propenylmalononitrile (the intermediate (18)).

Reference Production Example 13

Using 5.00 g of (2-methoxybenzylidene)malononitrile, 40 ml of
15 tetrahydrofuran, and a suspension of 0.31 g of sodium borohydride in 10 ml of ethanol, and according to the process described in Reference Production Example 8, there was obtained 3.56 g of (2-methoxybenzyl)malononitrile (the intermediate (20)).

Yield: 70%.

20 Reference Production Example 14

First, 9.18 g of (4-hydroxybenzyl)malononitrile was dissolved in 90 ml of N,N-dimethylformamide, to which 2.56 g of sodium hydride (60% in oil) was added, while stirring under ice cooling. After the evolution of hydrogen gas ceased, while stirring under ice cooling, 7.21 g of 4-bromo-1-butene was
25 added dropwise, followed by further stirring at room temperature overnight. Then, a saturated aqueous ammonium chloride solution was added to the reaction mixture, which was extracted with diethyl ether. The organic layer was successively washed with water, a saturated aqueous sodium chloride

solution, dried over anhydrous magnesium sulfate, and then concentrated under reduced pressure. The residue was subjected to silica gel column chromatography to give 10.3 g of 2-(3-butenyl)-2-(4-hydroxybenzyl)malononitrile (the intermediate (23)).

5 Yield: 86%.

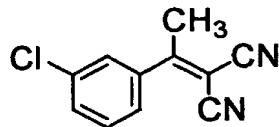
Reference Production Example 15

Using 5.23 g of (4-ethoxybenzylidene)malononitrile, 40 ml of tetrahydrofuran, and a suspension of 0.35 g of sodium borohydride in 10 ml of ethanol, and according to the process described in Reference Production
10 Example 8, there was obtained 2.76 g of (4-ethoxybenzyl)malononitrile (the intermediate (25)).

Yield: 52%.

Reference Production Example 16

Using 3.00 g of (3-chloro- α -methylbenzylidene)malononitrile of the
15 formula:

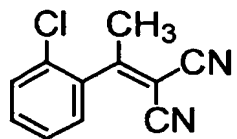


60 ml of diethyl ether, a catalytic amount of copper (I) iodide, and methyl magnesium iodide in diethyl ether (prepared from 0.90 g of magnesium, 30 ml of diethyl ether, and 2.58 ml of methyl iodide), and according to the pro-
20 cess described in Reference Production Example 1, there was obtained 2.33g of (1-(3-chlorophenyl)-1-methylethyl)malononitrile (the intermediate (26)).

Yield: 73%.

Reference Production Example 17

Using 3.00 g of (2-chloro- α -methylbenzylidene)malononitrile of the
25 formula:



60 ml of diethyl ether, a catalytic amount of copper (I) iodide, and methyl magnesium iodide in diethyl ether (prepared from 0.90 g of magnesium, 30 ml of diethyl ether, and 2.58 ml of methyl iodide), and according to the
5 process described in Reference Production Example 1, there was obtained 1.16g of (1-(2-chlorophenyl)-1-methylethyl)malononitrile (the intermediate (27)).

Yield: 36%.

Reference Production Example 18

10 Using 4.46 g of (2,3-dichlorobenzylidene)malononitrile, 20 ml of tetrahydrofuran, and a suspension of 0.21 g of sodium borohydride in 5 ml of ethanol, and according to the process described in Reference Production Example 8, there was obtained 3.07 g of (2,3-dichlorobenzyl)malononitrile (the intermediate (29)).

15 Yield: 68%.

Reference Production Example 19

Using 4.46 g of (2,6-dichlorobenzylidene)malononitrile, 20 ml of tetrahydrofuran, and a suspension of 0.21 g of sodium borohydride in 5 ml of ethanol, and according to the process described in Reference Production
20 Example 8, there was obtained 2.73 g of (2,6-dichlorobenzyl)malononitrile (the intermediate (30)).

Yield: 61%.

Reference Production Example 20

Using 4.88 g of (2,3,4,5,6-pentafluorobenzylidene)malononitrile, 20
25 ml of tetrahydrofuran, and a suspension of 0.21 g of sodium borohydride in 5 ml of ethanol, and according to the process described in Reference Production

Example 8, there was obtained 2.20 g of (2,3,4,5,6-pentafluorobenzyl)-malononitrile (the intermediate (31)).

Yield: 45%.

Reference Production Example 21

5 Using 1.02 g of (3-chlorobenzylidene)malononitrile, 20 ml of tetrahydrofuran, a catalytic amount of copper (I) iodide, and 10ml of isopropyl magnesium bromide in tetrahydrofuran (1.4 M), and according to the process described in Reference Production Example 2, there was obtained 0.71 g of (1-(3-chlorophenyl)-2-methylpropyl)malononitrile (the intermediate (32)).

10 Yield: 56%.

Reference Production Example 22

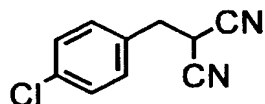
First, 13.2 g of (2,2-dimethylpropylidene)malononitrile and 10.5 g of benzaldehyde was dissolved in 800 ml of ethanol, to which 10.6 g of 1,2-phenylenediamine was added slowly while stirring, followed by stirring
15 overnight at room temperature. Then, the reaction mixture was concentrated under reduced pressure. Then, 300 ml of chloroform was added to the residue, the precipitate was filtered off, the filtrate was concentrated. And the same operation was repeated once more. The residue was subjected to silica gel column chromatography to give 8.50 g of (2,2-dimethyl-
20 propyl)malononitrile (the intermediate (34)).

Yield: 64%.

The intermediate compounds used in the production of the compounds are shown below with the compound numbers and physical data.

Intermediate (1)

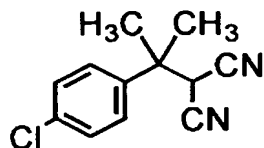
25 (4-Chlorobenzyl)malononitrile



m.p.: 96.9°C.

Intermediate (2)

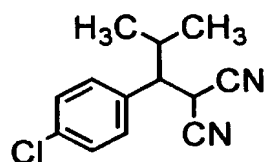
(1-(4-Chlorophenyl)-1-methylethyl)malononitrile

 $n_D^{22.0}$: 1.5372.

5

Intermediate (3)

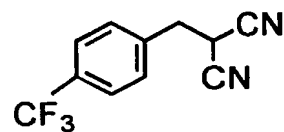
(1-(4-Chlorophenyl)-2-methylpropyl)malononitrile

 $n_D^{21.5}$: 1.5289.

Intermediate (4)

10

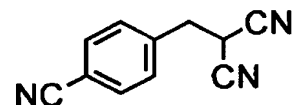
(4-(Trifluoromethyl)benzyl)malononitrile



m.p.: 79.1°C.

Intermediate (5)

(4-Cyanobenzyl)malononitrile

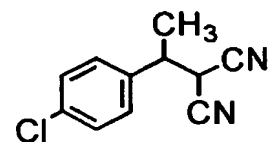


15

m.p.: 118.7°C.

Intermediate (6)

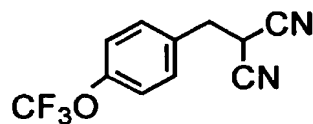
(1-(4-Chlorophenyl)ethyl)malononitrile



$n_D^{24.5}$: 1.5349.

Intermediate (7)

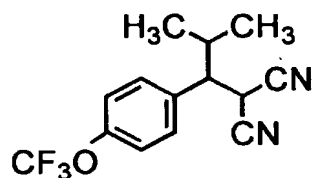
(4-(Trifluoromethoxy)benzyl)malononitrile



5 m.p.: 88.3°C.

Intermediate (8)

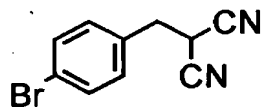
(1-(4-(Trifluoromethoxy)phenyl)-2-methylpropyl)malononitrile



$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 0.83 (3H, d), 1.16 (3H, d), 2.29-2.45
10 (1H, m), 2.87 (1H, dd), 4.18 (1H, d), 7.25-7.30 (2H, m), 7.38-7.42 (2H, m).

Intermediate (9)

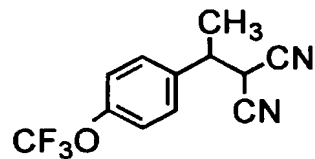
(4-Bromobenzyl)malononitrile



m.p.: 97.7°C.

15 Intermediate (10)

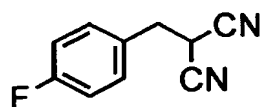
(1-(4-(Trifluoromethoxy)phenyl)ethyl)malononitrile



$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 1.65 (3H, d), 3.49 (1H, dq), 3.85 (1H,
20 d), 7.24-7.29 (2H, m), 7.38-7.42 (2H, m).

Intermediate (11)

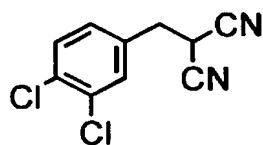
(4-Fluorobenzyl)malononitrile



m.p.: 117.2°C.

Intermediate (12)

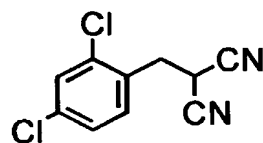
5 (3,4-Dichlorobenzyl)malononitrile



m.p.: 83.3°C.

Intermediate (13)

(2,4-Dichlorobenzyl)malononitrile

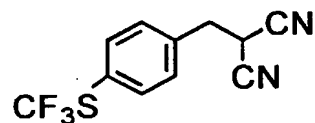


10

m.p.: 62.5°C.

Intermediate (14)

(4-(Trifluoromethylthio)benzyl)malononitrile

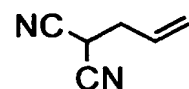


15

¹H-NMR (CDCl₃, TMS, δ (ppm)): 3.15 (2H, d), 3.95 (1H, t), 7.37 (2H, d), 7.70 (2H, d).

Intermediate (15)

Allylmalononitrile



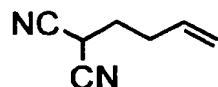
20

¹H-NMR (CDCl₃, TMS, δ (ppm)): 2.75 (2H, dd), 3.79 (1H, t), 5.36-5.45

(2H, m), 5.75-5.94 (1H, m).

Intermediate (16)

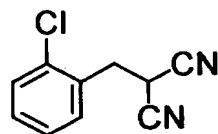
(3-Butenyl)malononitrile



- 5 $^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 2.11-2.18 (2H, m), 2.31-2.41 (2H, m), 3.76 (1H, t), 5.16-5.26 (2H, m), 5.64-5.79 (1H, m).

Intermediate (17)

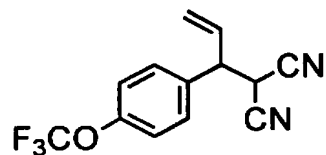
(2-chlorobenzyl)malononitrile



- 10 $n_D^{19.5}$: 1.5384.

Intermediate (18)

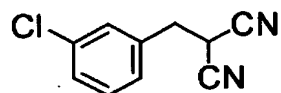
(1-(4-Trifluoromethoxyphenyl)-2-propenyl)malononitrile



- 15 $^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 3.95-4.03 (2H, m), 5.40-5.53 (2H, m), 6.08-6.19 (1H, m), 7.28 (2H, d), 7.39 (2H, d).

Intermediate (19)

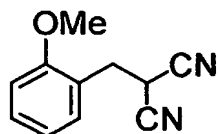
(3-chlorobenzyl)malononitrile



- $n_D^{19.5}$: 1.5403.

- 20 Intermediate (20)

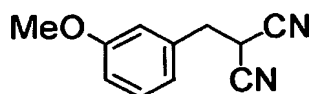
(2-methoxybenzyl)malononitrile



$n_D^{19.5}$: 1.5248.

Intermediate (21)

(3-methoxybenzyl)malononitrile

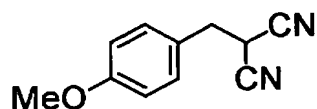


5

m.p.: 55.5°C.

Intermediate (22)

(4-methoxybenzyl)malononitrile

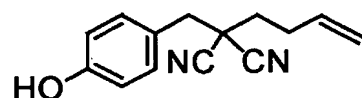


10

m.p.: 89.6°C.

Intermediate (23)

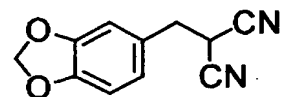
2-(3-butenyl)-2-(4-hydroxybenzyl)malononitrile



$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 1.99-2.05(2H, m), 2.43-2.51(2H, m),
 15 3.16(2H, s), 4.99(1H, bs), 5.09-5.20(2H, m), 5.74-5.86(1H, m), 6.85(2H, d),
 7.24(2H, d).

Intermediate (24)

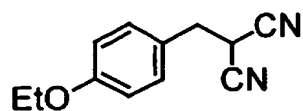
(3,4-(methylenedioxy)benzyl)malononitrile



$^1\text{H-NMR}$ (CDCl_3 , TMS, δ (ppm)): 3.19(2H, d), 3.87(1H, t), 5.98(2H, s),
 20 6.73-6.83(3H, m).

Intermediate (25)

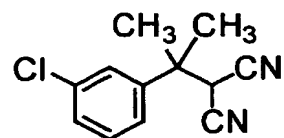
(4-ethoxybenzyl)malononitrile



m.p.: 118.0°C.

Intermediate (26)

5 (1-(3-chlorophenyl)-1-methylethyl)malononitrile



$n_D^{23.0}$: 1.5376.

Intermediate (27)

(1-(2-chlorophenyl)-1-methylethyl)malononitrile

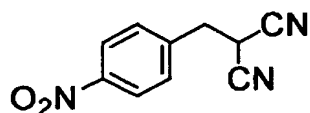


10

m.p.: 90.2°C.

Intermediate (28)

(4-nitrobenzyl)malononitrile

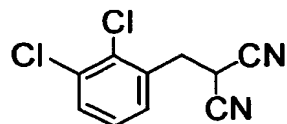


15

m.p.: 155.7°C.

Intermediate (29)

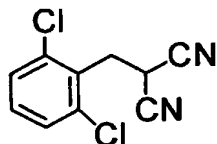
(2,3-dichlorobenzyl)malononitrile



$n_D^{22.5}$: 1.5518.

Intermediate (30)

(2,6-dichlorobenzyl)malononitrile

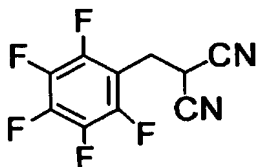


m.p.: 87.7°C.

5

Intermediate (31)

(2,3,4,5,6-pentafluorobenzyl)malononitrile

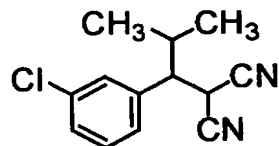


m.p.: 96.3°C.

Intermediate (32)

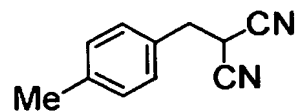
10

(1-(3-chlorophenyl)-2-methylpropyl)malononitrile

 $n_D^{21.5}$: 1.5268.

Intermediate (33)

(4-methylbenzyl)malononitrile

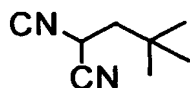


15

m.p.: 83.7°C.

Intermediate (34)

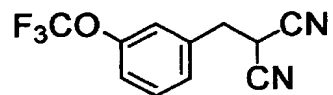
(2,2-dimethylpropyl)malononitrile



^1H -NMR (CDCl_3 , TMS, δ (ppm)): 1.07(9H, s), 2.04(2H, d), 3.66(1H, t).

Intermediate (35)

(3-(trifluoromethoxy)benzyl)malononitrile

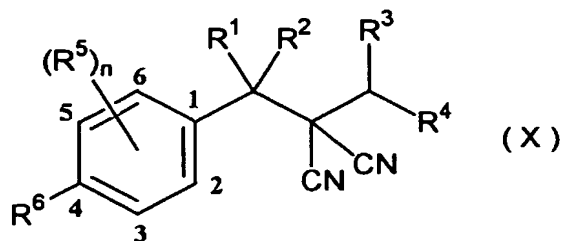


5 ^1H -NMR (CDCl_3 , TMS, δ (ppm)): 3.34(2H, d), 3.97(1H, t), 7.25-7.50(4H, m).

Specific examples of the compounds (X) are shown in Table 1 with their compound numbers.

TABLE 1

The compounds of formula (X):



| No. | R^1 | R^2 | R^3 | R^4 | $(R^5)_m$ | R^6 |
|-----|--------|--------------|------------------------|-------------------|-----------|---------|
| 1 | H | H | H | $CH=CH_2$ | — | Cl |
| 2 | CH_3 | CH_3 | H | $CH=CH_2$ | — | Cl |
| 3 | H | $CH(CH_3)_2$ | H | $CH=CH_2$ | — | Cl |
| 4 | H | H | H | $CH_2CH=CH_2$ | — | Cl |
| 5 | H | H | H | $CH=CH_2$ | — | CF_3 |
| 6 | H | H | H | $CH_2CH=CH_2$ | — | CN |
| 7 | H | H | H | $(CH_2)_2CH=CH_2$ | — | CN |
| 8 | H | H | H | $CH=CH_2$ | 2-Cl | H |
| 9 | H | H | $CH_2CH_2CH_2CH_2CH_2$ | — | — | Cl |
| 10 | H | CH_3 | H | $CH_2CH=CH_2$ | — | Cl |
| 11 | H | H | H | $CH=CH_2$ | — | OCF_3 |
| 12 | H | $CH(CH_3)_2$ | H | $CH_2CH=CH_2$ | — | OCF_3 |
| 13 | H | H | H | $CH=CH_2$ | — | Br |
| 14 | H | H | H | $CH=CH_2$ | — | CN |
| 15 | H | H | H | $CH_2CH=CH_2$ | — | OCF_3 |
| 16 | H | CH_3 | H | $CH_2CH=CH_2$ | — | OCF_3 |
| 17 | H | H | H | $CH=CH_2$ | 3-Cl | H |
| 18 | H | H | H | $CH=CH_2$ | — | F |
| 19 | H | H | H | $CH(CH_3)_2$ | — | Cl |

TABLE 1 (contn'd)

| No. | R ¹ | R ² | R ³ | R ⁴ | (R ⁵) _m | R ⁶ |
|-----|----------------|-----------------------------------|-----------------|--|--------------------------------|-------------------------------------|
| 20 | H | H | H | CH=CH ₂ | 2-OCH ₃ | H |
| 21 | H | H | H | (CH ₂) ₂ CH=CH ₂ | — | Cl |
| 22 | H | H | CH ₃ | CH=CH ₂ | — | Cl |
| 23 | H | H | H | CH=CH ₂ | 3-Cl | Cl |
| 24 | H | H | H | CH=CH ₂ | 2-Cl | Cl |
| 25 | H | H | H | CH=C(CH ₃) ₂ | — | Cl |
| 26 | H | CH(CH ₃) ₂ | H | CH ₂ CH=CH ₂ | — | Cl |
| 27 | H | H | H | CH=C(CH ₃) ₂ | — | OCF ₃ |
| 28 | H | H | H | CH=CH ₂ | 3-OCH ₃ | H |
| 29 | H | H | H | CH=CH ₂ | — | OCH ₃ |
| 30 | H | CH ₃ | H | CH=CH ₂ | — | OCF ₃ |
| 31 | H | CH ₂ Cl | H | CH=CH ₂ | — | OCF ₃ |
| 32 | H | CH=CH ₂ | H | CH ₂ CH=CH ₂ | — | OCF ₃ |
| 33 | H | CH=CH ₂ | H | CH=CH ₂ | — | OCF ₃ |
| 34 | H | CH=CH ₂ | H | C≡CH | — | OCF ₃ |
| 35 | H | H | H | CH ₂ CH=CH ₂ | — | OCBrF ₂ |
| 36 | H | H | H | CH ₂ CH=CH ₂ | — | OCHF ₂ |
| 37 | H | H | H | CH ₂ CH=CH ₂ | 3,4-OCH ₂ O | |
| 38 | H | H | H | CH ₂ CH=CH ₂ | — | OCH ₂ CH=CH ₂ |
| 39 | H | OCH ₃ | H | CH=CH ₂ | — | OCF ₃ |
| 40 | H | OCH ₂ CF ₃ | H | CH=CH ₂ | — | OCF ₃ |
| 41 | H | H | H | CH=CH ₂ | — | SCF ₃ |
| 42 | H | H | H | CH ₂ CH=CH ₂ | — | SCF ₃ |
| 43 | H | OCH ₃ | H | CH=CH ₂ | — | SCF ₃ |
| 44 | H | H | H | CH=CH ₂ | — | OCH ₂ CH ₃ |

TABLE 1 (contr'd)

| No. | R ¹ | R ² | R ³ | R ⁴ | (R ⁵) _m | R ⁶ |
|-----|-----------------|-----------------------------------|-----------------|---|--------------------------------|-----------------------------------|
| 45 | H | H | H | CH ₂ CH(CH ₃) ₂ | — | OCF ₃ |
| 46 | H | H | H | CH=CHCH ₃ | — | SCF ₃ |
| 47 | H | H | CH ₃ | CH=CH ₂ | — | SCF ₃ |
| 48 | CH ₃ | CH ₃ | H | CH=CH ₂ | 3-Cl | H |
| 49 | CH ₃ | CH ₃ | H | CH=CH ₂ | 2-Cl | H |
| 50 | H | H | H | CH=CH ₂ | — | NO ₂ |
| 51 | H | H | CH ₃ | CH ₃ | — | Cl |
| 52 | H | H | H | CH ₂ CH=CH ₂ | — | CF ₃ |
| 53 | H | H | H | CH=CH ₂ | 2,3-Cl ₂ | — |
| 54 | H | H | H | CH=CH ₂ | 2,6-Cl ₂ | — |
| 55 | H | CN | H | CH=CH ₂ | — | OCF ₃ |
| 56 | H | CN | H | CH=CH ₂ | — | SCF ₃ |
| 57 | H | H | H | CH=CH ₂ | 2-CF ₃ | CF ₃ |
| 58 | H | H | H | CH=CH ₂ | 2-Cl | CF ₃ |
| 59 | H | H | H | C≡CCH ₃ | — | OCF ₃ |
| 60 | H | H | H | CH ₂ CH=CH ₂ | 2-Cl | CF ₃ |
| 61 | H | H | H | CH=CH ₂ | — | S(O) ₂ CH ₃ |
| 62 | H | H | H | CH=CH ₂ | 2,3,5,6-F ₄ | F |
| 63 | H | H | H | CH=CH ₂ | 2-NO ₂ | CF ₃ |
| 64 | H | H | H | CH=CH ₂ | 2,6-Cl ₂ | CF ₃ |
| 65 | H | H | H | CH ₂ CH=CH ₂ | 2,6-Cl ₂ | CF ₃ |
| 66 | H | CH(CH ₃) ₂ | H | CH=CH ₂ | 3-Cl | H |
| 67 | H | H | H | CH ₂ CH=CH ₂ | 2-NO ₂ | CF ₃ |
| 68 | H | H | H | H | — | Cl |
| 69 | H | H | H | CH=CH ₂ | 3-F | CF ₃ |

TABLE 1 (contn'd)

| No. | R ¹ | R ² | R ³ | R ⁴ | (R ⁵) _m | R ⁶ |
|-----|----------------|----------------------------------|----------------|---|-------------------------------------|------------------------------------|
| 70 | H | H | H | CH=CH ₂ | — | SCH ₃ |
| 71 | H | H | H | C ₂ H ₅ | — | CF ₃ |
| 72 | H | H | H | CH ₃ | — | Cl |
| 73 | H | H | H | (Z)-CH ₂ CH=CHCH ₂ CH ₃ | — | Cl |
| 74 | H | CH ₃ | H | CH=CH ₂ | — | Cl |
| 75 | H | H | H | CH ₃ | — | CF ₃ |
| 76 | H | CH ₃ | H | CH ₂ CH ₂ CH=CH ₂ | — | Cl |
| 77 | H | H | H | CH=CH ₂ | — | CH ₃ |
| 78 | H | H | H | CH ₂ CH=CH ₂ | — | OC(=O)CH ₃ |
| 79 | H | H | H | (CH ₂) ₂ CH=CH ₂ | — | CF ₃ |
| 80 | H | H | H | CH ₂ CH=CH ₂ | — | OCF ₂ CF ₂ H |
| 81 | H | H | H | CH ₂ CH=CH ₂ | — | OCH ₂ CF ₃ |
| 82 | H | OCH ₂ CH ₃ | H | CH=CH ₂ | — | OCF ₃ |
| 83 | H | OCH ₃ | H | CH=CH ₂ | — | CN |
| 84 | H | OCH ₃ | H | CH=CH ₂ | — | Cl |
| 85 | H | H | H | C(CH ₃) ₃ | — | OCF ₃ |
| 86 | H | H | H | C(CH ₃) ₃ | — | Br |
| 87 | H | H | H | CH(CH ₃) ₂ | — | OCF ₃ |
| 88 | H | H | H | CH ₂ CH ₂ CH ₂ CH ₃ | — | OCF ₃ |
| 89 | H | H | H | CH=CH ₂ | 3-OCF ₃ | H |
| 90 | H | H | H | CH ₂ CH=CH ₂ | 3-OCF ₃ | H |
| 91 | H | CN | H | CH=CH ₂ | — | OCH ₃ |
| 92 | H | CN | H | CH=CH ₂ | — | CH ₃ |
| 93 | H | CN | H | CH=CH ₂ | — | C(=O)OCH ₃ |
| 94 | H | H | H | CH ₂ CH=CH ₂ | 3,5-(CF ₃) ₂ | H |

TABLE 1 (contn'd)

| No. | R ¹ | R ² | R ³ | R ⁴ | (R ⁵) _m | R ⁶ |
|-----|----------------|----------------------------------|-----------------|---|--------------------------------------|--|
| 95 | H | H | H | CH=CH ₂ | 2,3-(OCH ₃) ₂ | H |
| 96 | H | H | H | CH=CH ₂ | — | CH=CH ₂ |
| 97 | H | H | H | CH=CH ₂ | — | C(=O)CH ₃ |
| 98 | H | H | H | CH ₂ CH=CH ₂ | — | OCH ₂ CH ₃ |
| 99 | H | H | H | CH ₂ CH=CH ₂ | — | OCH ₂ CH ₂ CH ₃ |
| 100 | H | H | H | CH ₂ CH=CH ₂ | — | OCH(CH ₃) ₂ |
| 101 | H | H | H | CH=CH ₂ | — | CH ₂ CH ₃ |
| 102 | H | H | H | CH=CH ₂ | — | CH(CH ₃) ₂ |
| 103 | H | C(CH ₃) ₃ | H | CH=CH ₂ | — | OCF ₃ |
| 104 | H | H | H | CH ₂ CH ₂ CH ₂ CH ₃ | — | CF ₃ |
| 105 | H | H | H | CH ₂ CH(CH ₃) ₂ | — | CF ₃ |
| 106 | H | H | H | CH=C(CH ₃) ₂ | — | CF ₃ |
| 107 | H | H | H | CH=CHCH ₃ | — | CF ₃ |
| 108 | H | H | H | C(CH ₃)=CH ₂ | — | CF ₃ |
| 109 | H | H | H | CH ₂ CH ₂ CH ₃ | — | CF ₃ |
| 110 | H | H | H | CH(CH ₃) ₂ | — | CF ₃ |
| 111 | H | H | CH ₃ | CH ₂ CH ₃ | — | CF ₃ |
| 112 | H | H | CH ₃ | CH ₂ CH ₂ CH ₃ | — | CF ₃ |
| 113 | H | H | CH ₃ | CH ₂ CH ₂ CH ₂ CH ₃ | — | CF ₃ |
| 114 | H | H | H | CH=CH ₂ | 2,3-F ₂ | H |
| 115 | H | H | H | CH=CH ₂ | — | OCH(CH ₃)CH ₂ CH ₃ |
| 116 | H | H | H | CH=CH ₂ | 3-OPh | F |
| 117 | H | H | H | CH=CH ₂ | — | S(p-CH ₃ Ph) |
| 118 | H | H | H | CH=CH ₂ | 3-OPh | H |
| 119 | H | H | H | CH=CH ₂ | — | O(m-CH ₃ Ph) |

TABLE 1 (contn'd)

| No. | R ¹ | R ² | R ³ | R ⁴ | (R ⁵) _m | R ⁶ |
|-----|-----------------|-----------------------------------|----------------|---|--------------------------------|-----------------|
| 120 | H | H | H | CH=CH ₂ | 2,6-F ₂ | F |
| 121 | H | H | H | CH=CH ₂ | — | O(p-ClPh) |
| 122 | H | H | H | CH ₂ CH(CH ₃) ₂ | 3-Cl | Cl |
| 123 | H | H | H | CH ₂ CH(CH ₃) ₂ | — | Cl |
| 124 | H | H | H | CH ₂ CH(CH ₃) ₂ | — | CN |
| 125 | H | H | H | CH ₂ CH(CH ₃) ₂ | — | NO ₂ |
| 126 | H | H | H | CH ₂ CH(CH ₃) ₂ | 3-F | CF ₃ |
| 127 | H | H | H | CH ₂ CH(CH ₃) ₂ | 3-Cl | CN |
| 128 | H | CH ₃ | H | CH ₂ CH(CH ₃) ₂ | — | CF ₃ |
| 129 | H | CH ₃ | H | CH ₂ CH(CH ₃) ₂ | — | Cl |
| 130 | H | CH ₃ | H | CH ₂ CH(CH ₃) ₂ | — | CN |
| 131 | H | CH(CH ₃) ₂ | H | CH ₂ CH(CH ₃) ₂ | — | CF ₃ |
| 132 | H | H | H | CH ₂ CH(CH ₃) ₂ | 3-CF ₃ | H |
| 133 | H | H | H | CH ₂ CH(CH ₃) ₂ | — | CF ₃ |
| 134 | CH ₃ | CH ₃ | H | CH ₂ CH(CH ₃) ₂ | — | CN |
| 135 | CH ₃ | CH ₃ | H | CH ₂ CH(CH ₃) ₂ | 3-Cl | Cl |
| 136 | H | H | H | CH ₂ C(CH ₃) ₃ | — | CF ₃ |
| 137 | H | H | H | CH ₂ C(CH ₃) ₃ | — | Cl |
| 138 | H | H | H | CH ₂ C(CH ₃) ₃ | — | CN |
| 139 | H | H | H | CH ₂ C(CH ₃) ₃ | — | NO ₂ |
| 140 | H | H | H | CH ₂ C(CH ₃) ₃ | 3-Cl | CF ₃ |
| 141 | H | H | H | CH ₂ C(CH ₃) ₃ | 3-F | CN |
| 142 | H | CH ₃ | H | CH ₂ C(CH ₃) ₃ | — | CF ₃ |
| 143 | H | CH ₃ | H | CH ₂ C(CH ₃) ₃ | 3-F | CF ₃ |
| 144 | H | CH(CH ₃) ₂ | H | CH ₂ C(CH ₃) ₃ | 3-F | CF ₃ |

TABLE 1 (contn'd)

| No. | R ¹ | R ² | R ³ | R ⁴ | (R ⁵) _m | R ⁶ |
|-----|----------------|-----------------------------------|----------------|---|--------------------------------|-----------------|
| 145 | H | CH(CH ₃) ₂ | H | CH ₂ C(CH ₃) ₃ | - | CF ₃ |
| 146 | H | H | H | CH ₂ C(CH ₃) ₃ | 3-F | Cl |
| 147 | H | H | H | CH ₂ C(CH ₃) ₃ | 3-Cl | F |
| 148 | H | H | H | CH=CH ₂ | 3-Cl | CF ₃ |
| 149 | H | CH ₃ | H | CH=CH ₂ | 3-F | CF ₃ |
| 150 | H | H | H | CH=CH ₂ | 3-CF ₃ | H |
| 151 | H | H | H | CH=CH ₂ | 3-Cl | CN |
| 152 | H | H | H | CH ₂ CH=CH ₂ | 3-Cl | CF ₃ |
| 153 | H | H | H | CH ₂ CH=CH ₂ | 3-F | CF ₃ |
| 154 | H | H | H | CH ₂ CH=CH ₂ | 3-F | CN |
| 155 | H | H | H | CH ₂ CH=CH ₂ | 3-Cl | F |
| 156 | H | CH ₃ | H | CH ₂ CH=CH ₂ | 3-F | Cl |
| 157 | H | CH ₃ | H | CH=C(CH ₃) ₂ | 3-F | Cl |
| 158 | H | H | H | CH=C(CH ₃) ₂ | 3-Cl | CF ₃ |
| 159 | H | H | H | CH=C(CH ₃) ₂ | 3-F | CF ₃ |
| 160 | H | CH(CH ₃) ₂ | H | CH=C(CH ₃) ₂ | - | CF ₃ |
| 161 | H | H | H | CH=C(CH ₃) ₂ | 3-CF ₃ | H |
| 162 | H | H | H | CH ₂ CH=C(CH ₃) ₂ | - | CF ₃ |
| 163 | H | H | H | CH ₂ CH=C(CH ₃) ₂ | - | CN |
| 164 | H | H | H | CH ₂ CH=C(CH ₃) ₂ | - | NO ₂ |
| 165 | H | H | H | CH ₂ CH ₃ | 3-F | CF ₃ |
| 166 | H | H | H | CH ₂ CH ₃ | - | CN |
| 167 | H | H | H | CH ₂ CH ₃ | - | Cl |
| 168 | H | H | H | CH ₂ CH ₃ | - | NO ₂ |
| 169 | H | CH ₃ | H | CH ₂ CH ₃ | - | CF ₃ |

TABLE 1 (contn'd)

| No. | R ¹ | R ² | R ³ | R ⁴ | (R ⁵) _m | R ⁶ |
|-----|----------------|-------------------|----------------|---|--------------------------------|------------------|
| 170 | H | CH ₃ | H | CH ₂ CH ₃ | — | CN |
| 171 | H | H | H | CH ₂ CH ₂ CH ₃ | 3-F | Cl |
| 172 | H | H | H | CH ₂ CH ₂ CH ₃ | 3-Cl | F |
| 173 | H | H | H | CH ₂ CH ₂ CH ₃ | 3-F | CF ₃ |
| 174 | H | CH ₃ | H | CH ₂ CH ₂ CH ₃ | 3-CF ₃ | H |
| 175 | H | H | H | CH ₂ CH ₃ | 3-CF ₃ | H |
| 176 | H | H | H | CH ₂ CH ₂ CH ₃ | 3-CF ₃ | H |
| 177 | H | CH ₂ F | H | CH ₂ CH=CH ₂ | — | CF ₃ |
| 178 | H | H | H | CH ₂ CH ₂ CH ₃ | — | SCF ₃ |
| 179 | H | H | H | CH ₂ CH ₃ | — | OCF ₃ |
| 180 | H | CF ₃ | H | CH ₂ CH ₃ | 3-F | CF ₃ |

The following will describe some formulation examples wherein parts represent parts by weight. The compounds (X) are designated by their compound numbers shown in Table 1.

5 Formulation Example 1

Nine (9) parts of each of compounds 1 to 120 is dissolved in 37.5 parts of xylene and 37.5 parts of dimethylformamide, and 10 parts of polyoxyethylene styryl phenyl ether and 6 parts of calcium dodecylbenzenesulfonate are added thereto, followed by well stirring and mixing, to give an emulsi-
 10 fiable concentrate for each compound.

Formulation Example 2

To 40 parts of each of compounds 1 to 120 is added 5 parts of Sorpol® 5060 (Toho Chemical Industry Co., Ltd.), followed by well mixing, and 32 parts of Carplex® #80 (synthetic hydrated silicone oxide fine powder; Shionogi & Co., Ltd.) and 23 parts of 300 mesh diatomaceous earth are added,
 15

which is mixed with a mixer to give a wettable powder for each compound.

Formulation Example 3

To 3 parts of each of compounds 1 to 120 are added 5 parts of synthetic hydrated silicon oxide fine powder, 5 parts of sodium dodecylbenzenesulfonate, 30 parts of bentonite, and 57 parts of clay, followed by well stirring and mixing, and an appropriate amount of water is added to this mixture, followed by further stirring, granulation with a granulator, and air drying, to give a granule for each compound.

Formulation Example 4

First, 4.5 parts of each of compounds 1 to 120, 1 part of synthetic hydrated silicon oxide fine powder, 1 part of Doriresu B (Sankyo Co., Ltd.) as a flocculant, and 7 parts of clay are well mixed with a mortar, followed by stirring and mixing with a mixer. To the resulting mixture is added 86.5 parts of cut clay, followed by well stirring and mixing, to give a dust for each compound.

Formulation Example 5

Ten parts of each of compounds 1 to 120, 35 parts of white carbon containing 50 parts of polyoxyethylene alkyl ether sulfate ammonium salt, and 55 parts of water are mixed and pulverized by the wet grinding method to give a formulation for each compound.

Formulation Example 6

First, 0.5 parts of each of compounds 1 to 120 is dissolved in 10 parts of dichloromethane, which is mixed with 89.5 parts of ISOPAR® M (isoparaffin; Exxon Chemical Co.) to give an oil formulation for each compound.

Formulation Example 7

First, 0.1 parts of compounds 1 to 120 and 49.9 parts of NEO-CHIOZOL (Chuo Kasei K.K.) are put into an aerosol can, to which an aerosol

valve is attached. Then, 25 parts of dimethyl ether and 25 parts of LPG are filled in the aerosol can, followed by shaking and attachment of an actuator, to give an oil-based aerosol.

Formulation Example 8

5 First, 0.6 parts of each of compounds 1 to 120, 0.01 parts of BHT, 5 parts of xylene, 3.39 parts of deodorized kerosine, and 1 part of an emulsifier (Atmos 300; Atmos Chemical Co.) are mixed to become a solution. Then, this solution and 50 parts of distilled water are filled in an aerosol can, to which a valve part is attached, and 40 parts of a propellant (LPG) is filled
10 under pressure through the valve in the aerosol can to give a water-based aerosol.

The following test example will demonstrate that the compounds (X) are useful as the active ingredients of pesticide compositions. The compounds (X) are designated by their compound numbers shown in Table 1.

15 Test Example 1 Pesticidal Test against *Nilaparvata lugens*

Each formulation of the compound 11, 12, 16, 27, 30, 31, 32, 33, 34, 37, 40, 41, 42, 47, 49, 52, 56, 58, 59, 60, 63, 64, 65, 67, 69, 71, 75, 79, 87, 88, 89, 90, 98, 100, 102, 105, 106, 108, 109, 110, 114, 115, 116, 117, 118 and 119 obtained according to Formulation Example 5 was diluted with water so that
20 the active ingredient concentration came to 500 ppm to prepare a test liquid for each compound.

Fifty grams of molding Bonsoru 2 (available from Sumitomo Chemical Co., Ltd.) was put into a polyethylene cup, and 10 to 15 seeds of rice were planted in the polyethylene cup. Then rice plants were grown until the
25 second foliage leaves developed and then cut into the same height of 5 cm. The test liquid, which had been prepared as described above, was sprayed at the rate of 20 ml/cup onto these rice plants. After the test liquid sprayed onto the rice plants were dried, the polyethylene cup with the rice plants was

placed in a large polyethylene cup and 30 first-instar larvae of *Nilaparvata lugens* (brown planthopper) were set free in the large polyethylene cup, which was then kept covered and left in a greenhouse at 25°C. On the 6th day after the release of larvae of *Nilaparvata lugens*, the number of parasitic
5 *Nilaparvata lugens* on the rice plants was examined.

As a result, in the treatment with each of the compounds described above, the number of parasitic pests on the 6th day after the treatment was not greater than 3.

Test Example 2 Pesticidal Test against *Nilaparvata lugens*

10 Each formulation of the compound 11, 12, 16, 41, 45, 47, 49, 52, 54, 58, 68, 69, 71, 75, 87, 90, 105, 106, 108, 109 and 110 obtained according to Formulation Example 5 was diluted with water so that the active ingredient concentration came to 45.5 ppm to prepare a test liquid for each compound.

Fifty grams of molding Bonsoru 2 (available from Sumitomo Chemical Co., Ltd.) was put into a polyethylene cup having five holes of 5 mm, and
15 10 to 15 seeds of rice were planted in the polyethylene cup. Then rice plants were grown until the second foliage leaves developed and the polyethylene cup with the rice plants was placed in a large polyethylene cup containing 55 ml of the test liquid, which had been prepared as described above. The rice
20 plants were left in a greenhouse at 25°C for 6 days and then cut into the same height of 5 cm. Thirty first-instar larvae of *Nilaparvata lugens* (brown planthoppers) were set free in the large polyethylene cup, which was then kept covered and left in a greenhouse at 25°C. On the 6th day after the release of larvae of *Nilaparvata lugens*, the number of parasitic
25 *Nilaparvata lugens* on the rice plants was examined.

As a result, in the treatment with each of the compounds described above, the number of parasitic pests on the 6th day after the treatment was not greater than 3.

Test Example 3 Pesticidal Test against *Nilaparvata lugens*

Each formulation of the compound 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, 29, 44, 48, 49, 51, 62, 66, 73, 74, 76 and 77 obtained according to Formulation Example 1 was diluted with
5 water so that the active ingredient concentration came to 500 ppm to prepare a test liquid for each compound.

A bundle of 3 to 4 of cotyledons (height of 3 to 5 cm) of rice was immersed in the test liquid, which had been prepared as described above, for 1 minute. After the test liquid treated the rice plants was dried, a filter
10 paper moistened with 1 ml of water was place on a bottom of polyethylene cup and then the bundle of cotyledons of rice was placed on it. Thirty first-instar larvae of *Nilaparvata lugens* (brown planthoppers) were set free in the polyethylene cup, which was then kept covered and left in a greenhouse at 25°C. On the 6th day after the release of larvae of *Nilaparvata lugens*, the
15 number of parasitic *Nilaparvata lugens* on the rice plants was examined.

As a result, in the treatment with each of the compounds described above, the number of parasitic pests on the 6th day after the treatment was not greater than 3.

Test Example 4 Pesticidal Test against *Diabrotica undecimpunctata*
20 *ctata*

Each formulation of the compound 1, 2, 3, 4, 5, 9, 10, 11, 12, 16, 19, 21, 22, 23, 24, 26, 66, 74 and 76 obtained according to Formulation Example 1 was diluted with water so that the active ingredient concentration came to 50 ppm to prepare a test liquid for each compound.

25 On the bottom of a polyethylene cup of 5 cm in diameter was placed a filter paper, to which the test liquid had been prepared as described above, was added dropwise in an amount of 1 ml. One germinated seed of corn and 30 to 50 eggs of *Diabrotica undecimpunctata* (southern corn rootworm) was

placed on the filter paper in the polyethylene cup, which was then kept covered and left in a room at 25°C. On the 6th day after, the number of surviving larvae of *Diabrotica undecimpunctata* was examined.

As a result, in the treatment with each of the compounds described
5 above, the number of surviving pests on the 6th day after was 0.

Test Example 5 Pesticidal Test against *Musca domestica*

Each formulation of the compound 1, 3, 4, 10, 11, 15, 17, 22, 24, 30, 31,
32, 33, 34, 35, 36, 37, 39, 40, 41, 42, 43, 45, 46, 47, 52, 55, 56, 57, 58, 59, 60,
64, 65, 66, 67, 68, 69, 71, 74, 75, 79, 82, 84, 89, 90, 92, 101, 102, 105, 107, 108,
10 109, 110, 111, 114, 115 and 120 obtained according to Formulation Example 5
was diluted with water so that the active ingredient concentration came to
500 ppm to prepare a test liquid for each compound.

On the bottom of a polyethylene cup of 5.5 cm in diameter was placed
a filter paper on the same size, to which the test liquid had been prepared as
15 described above, was added dropwise in an amount of 0.7 ml, and 30 mg of
sucrose as a bait was placed on it. Ten female adults of *Musca domestica*
(house fly) were set free in the polyethylene cup, which was then kept
covered. After 24 hours, their survival was examined to determine the
mortality.

20 As a result, in the treatment with each of the compounds described
above, it was exhibited the mortality of 100%.

Test Example 6 Pesticidal Test against German cockroach

Each formulation of the compound 1, 2, 3, 4, 5, 9, 10, 11, 12, 15, 16, 17,
23, 30, 31, 32, 33, 36, 39, 40, 41, 42, 43, 46, 47, 52, 55, 56, 57, 58, 59, 60, 64,
25 68, 69, 74, 79, 84, 89, 102, 109, 110, 114, 119, 120 and 121 obtained in
Formulation Example 5 was diluted with water so that the active ingredient
concentration came to 500 ppm to prepare a test liquid for each compound.

On the bottom of a polyethylene cup of 5.5 cm in diameter was placed

a filter paper on the same size, to which the test liquid had been prepared as described above, was added dropwise in an amount of 0.7 ml, and 30 mg of sucrose as a bait was placed on it. Two male adults of German cockroach (*Blattella germanica*) were set free in the polyethylene cup, which was then
5 kept covered. After 6 days, their survival was examined to determine the mortality.

As a result, in the treatment with each of the compounds described above, it was exhibited the mortality of 100%.

Test Example 7 Pesticidal Test against *Culex pipiens pallens*

10 Each formulation of the compound 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 15, 16, 17, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 52, 54, 55, 56, 57, 58, 59, 60, 61, 63, 64, 65, 66, 67, 68, 69, 70, 71, 74, 75, 76, 78, 79, 80, 81, 82, 83, 84, 89, 91, 92, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113,
15 115, 116, 118 and 121 obtained according to Formulation Example 5 was diluted with water so that the active ingredient concentration came to 500 ppm to prepare a test liquid for each compound.

In 100 ml of ion-exchanged water, the test liquid had been prepared as described above, was added dropwise in an amount of 0.7 ml (the
20 concentration of active ingredient was 3.5 ppm). Twenty final-instar larvae of *Culex pipiens pallens* (common mosquito) were set free in the solution. After 1 days, their survival was examined to determine the mortality. As a result, in the treatment with each of the compounds described above, it was exhibited the mortality of 100%.

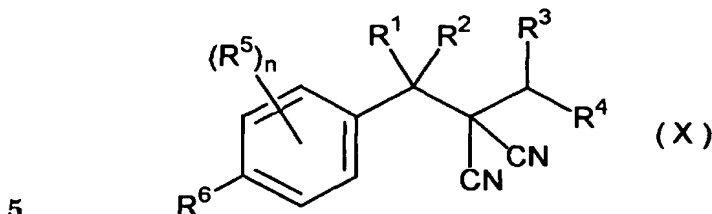
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Industrial Applicability

The present invention makes it possible to effectively control pests such as insect pests, acarine pests, and nematode pests.

CLAIMS

1. A pesticide composition comprising a malononitrile compound of formula (X):



wherein R^1 and R^2 are the same or different and independently C_1 - C_6 (halo)-alkyl, C_1 - C_6 (halo)alkyloxy, C_2 - C_6 (halo)alkenyl, C_2 - C_6 (halo)alkynyl, hydrogen, or cyano;

R^3 and R^4 are the same or different and independently C_1 - C_{10} alkyl, C_2 - C_{10} alkenyl, C_2 - C_{10} alkynyl, or hydrogen, or R^3 and R^4 are taken together to form C_2 - C_6 (halo)alkylene or C_4 - C_6 (halo)alkenylene;

R^5 is halogen, cyano, nitro, C_1 - C_4 (halo)alkyl, C_2 - C_4 (halo)alkenyl, C_2 - C_4 (halo)alkynyl, C_1 - C_4 (halo)alkyloxy, C_1 - C_4 (halo)alkylthio, C_1 - C_4 (halo)alkylsulfinyl, C_1 - C_4 (halo)alkylsulfonyl, C_1 - C_4 (halo)alkylcarbonyl, C_1 - C_4 (halo)alkyloxycarbonyl, C_1 - C_4 (halo)alkylcarbonyloxy, phenyloxy, or phenylthio, in which the phenyloxy and phenylthio groups may optionally be substituted with halogen or C_1 - C_3 alkyl;

n is an integer of 0 to 4;

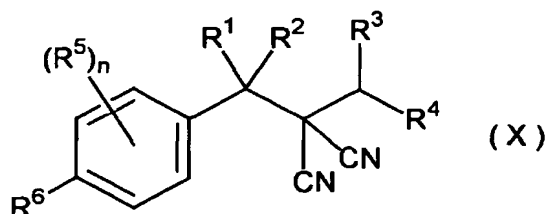
R^6 is hydrogen, halogen, cyano, nitro, C_1 - C_4 (halo)alkyl, C_2 - C_4 (halo)alkenyl, C_2 - C_4 (halo)alkynyl, C_1 - C_4 (halo)alkyloxy, C_1 - C_4 (halo)alkylthio, C_1 - C_4 (halo)alkylsulfinyl, C_1 - C_4 (halo)alkylsulfonyl, C_1 - C_4 (halo)alkylcarbonyl, C_1 - C_4 (halo)alkyloxycarbonyl, C_1 - C_4 (halo)alkylcarbonyloxy, phenyloxy, or phenylthio, in which the phenyloxy and phenylthio groups may optionally be substituted with halogen or C_1 - C_3 alkyl;

or R^5 and R^6 are taken together to form methylenedioxy;

with the provisos that when R^6 is hydrogen, then n is an integer of 1 to 4 and that when n is 2 or more, then R^5 's are the same or different from each other; as an active ingredient, and a carrier.

2. The pesticide composition according to claim 1, wherein a
5 containing amount of the malononitrile compound is 0.1% to 95% by weight.

3. A pest controlling method comprising applying an pesti-
cally effective amount of a malononitrile compound of formula (X):



wherein R^1 and R^2 are the same or different and independently C_1 - C_5 (halo)-
10 alkyl, C_1 - C_5 (halo)alkoxy, C_2 - C_5 (halo)alkenyl, C_2 - C_5 (halo)alkynyl, hydrogen,
or cyano;

R^3 and R^4 are the same or different and independently C_1 - C_{10} alkyl,
 C_2 - C_{10} alkenyl, C_2 - C_{10} alkynyl, or hydrogen, or R^3 and R^4 are taken together to
form C_2 - C_6 (halo)alkylene or C_4 - C_6 (halo)alkenylene;

15 R^5 is halogen, cyano, nitro, C_1 - C_4 (halo)alkyl, C_2 - C_4 (halo)alkenyl, C_2 -
 C_4 (halo)alkynyl, C_1 - C_4 (halo)alkoxy, C_1 - C_4 (halo)alkylthio, C_1 - C_4 (halo)-
alkylsulfinyl, C_1 - C_4 (halo)alkylsulfonyl, C_1 - C_4 (halo)alkylcarbonyl, C_1 - C_4
(halo)alkyloxycarbonyl, C_1 - C_4 (halo)alkylcarbonyloxy, phenoxy, or phenyl-
thio, in which the phenoxy and phenylthio groups may optionally be sub-
20 stituted with halogen or C_1 - C_3 alkyl;

n is an integer of 0 to 4;

R^6 is hydrogen, halogen, cyano, nitro, C_1 - C_4 (halo)alkyl, C_2 - C_4 (halo)-
alkenyl, C_2 - C_4 (halo)alkynyl, C_1 - C_4 (halo)alkoxy, C_1 - C_4 (halo)alkylthio, C_1 - C_4
(halo)alkylsulfinyl, C_1 - C_4 (halo)alkylsulfonyl, C_1 - C_4 (halo)alkylcarbonyl, C_1 - C_4
25 (halo)alkyloxycarbonyl, C_1 - C_4 (halo)alkylcarbonyloxy, phenoxy, or phenyl-

thio, in which the phenyloxy and phenylthio groups may optionally be substituted with halogen or C₁-C₃ alkyl;

or R⁵ and R⁶ are taken together to form methylenedioxy;

with the provisos that when R⁶ is hydrogen, then n is an integer of 1
5 to 4 and that when n is 2 or more, then R⁵'s are the same or different from each other; to pests or habitats of pests.

4. The pest controlling method according to claim 3, wherein R⁶ is halogen, cyano, nitro, C₁-C₄ haloalkyl, C₁-C₄ haloalkyloxy or C₁-C₄ haloalkylthio.

10 5. The pest controlling method according to claim 3, wherein R³ and R⁴ are the same or different and independently C₁-C₅ alkyl, C₂-C₅ alkenyl, C₂-C₅ alkynyl, or hydrogen, or R³ and R⁴ are taken together to form C₂-C₅ (halo)alkylene.

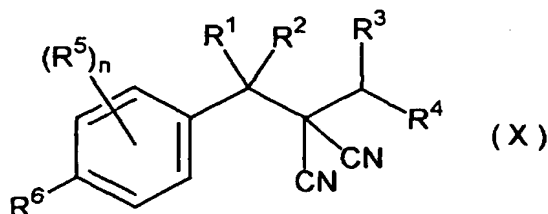
15 6. The pest controlling method according to claim 3, wherein R¹ and R² are both hydrogen.

7. The pest controlling method according to claim 3, wherein R¹ and R² are the same or different and independently C₁-C₃ (halo)alkyl, C₁-C₃ (halo)alkyloxy, C₂-C₄ (halo)alkenyl, C₂-C₄ (halo)alkynyl, hydrogen, or cyano; R⁵ and R⁶ are the same or different and independently halogen, cyano, nitro,
20 C₁-C₃ haloalkyl, C₁-C₃ haloalkyloxy, C₁-C₃ (halo)alkylthio, C₁-C₃ (halo)alkylsulfinyl, C₁-C₃ (halo)alkylsulfonyl, C₁-C₃ (halo)alkylcarbonyl, or C₁-C₃ haloalkyloxycarbonyl.

8. The pest controlling method according to claim 7, wherein R³ is hydrogen and R⁴ are vinyl, allyl, ethyl, 3-butenyl and 1-propenyl.

25 9. The pest controlling method according to claim 3, wherein the pests are insect pests.

10. Use of a malononitrile compound of formula (X):



wherein R^1 and R^2 are the same or different and independently C_1 - C_6 (halo)-alkyl, C_1 - C_6 (halo)alkyloxy, C_2 - C_6 (halo)alkenyl, C_2 - C_6 (halo)alkynyl, hydrogen, or cyano;

- 5 R^3 and R^4 are the same or different and independently C_1 - C_{10} alkyl, C_2 - C_{10} alkenyl, C_2 - C_{10} alkynyl, or hydrogen, or R^3 and R^4 are taken together to form C_2 - C_6 (halo)alkylene or C_4 - C_6 (halo)alkenylene;

- R^5 is halogen, cyano, nitro, C_1 - C_4 (halo)alkyl, C_2 - C_4 (halo)alkenyl, C_2 - C_4 (halo)alkynyl, C_1 - C_4 (halo)alkyloxy, C_1 - C_4 (halo)alkylthio, C_1 - C_4 (halo)-alkylsulfinyl, C_1 - C_4 (halo)alkylsulfonyl, C_1 - C_4 (halo)alkylcarbonyl, C_1 - C_4 (halo)alkyloxycarbonyl, C_1 - C_4 (halo)alkylcarbonyloxy, phenyloxy, or phenylthio, in which the phenyloxy and phenylthio groups may optionally be substituted with halogen or C_1 - C_3 alkyl;

n is an integer of 0 to 4;

- 15 R^6 is hydrogen, halogen, cyano, nitro, C_1 - C_4 (halo)alkyl, C_2 - C_4 (halo)-alkenyl, C_2 - C_4 (halo)alkynyl, C_1 - C_4 (halo)alkyloxy, C_1 - C_4 (halo)alkylthio, C_1 - C_4 (halo)alkylsulfinyl, C_1 - C_4 (halo)alkylsulfonyl, C_1 - C_4 (halo)alkylcarbonyl, C_1 - C_4 (halo)alkyloxycarbonyl, C_1 - C_4 (halo)alkylcarbonyloxy, phenyloxy, or phenylthio, in which the phenyloxy and phenylthio groups may optionally be substituted with halogen or C_1 - C_3 alkyl;

or R^5 and R^6 are taken together to form methylenedioxy;

with the provisos that when R^6 is hydrogen, then n is an integer of 1 to 4 and that when n is 2 or more, then R^5 's are the same or different from each other; as an active ingredient of a pesticide composition.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 02/04450

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A01N37/34 A01N37/36 A01N37/38 A01N37/42 A01N41/10
A01N43/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C07C A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

27 September 2002

Date of mailing of the international search report

08/10/2002

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Authorized officer

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 02/04450

| C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT | | |
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